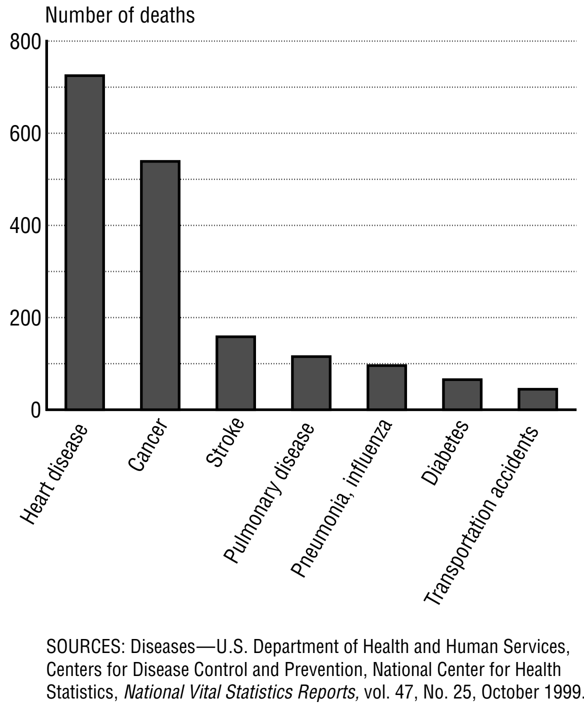
Chapter 3
Transportation Safety

Introduction

The highest priority of the U.S. Department of Transportation (DOT) is to "promote public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage" [1]. The United States has made much progress in reducing the number of transportation-related deaths, but crashes and incidents involving transportation vehicles, vessels, aircraft, and pipelines still claimed nearly 44,000 lives and injured more than 3 million people in 1999. Transportation accidents are the seventh single leading cause of death in the United States (figure 1). However, motor vehicle crashes are the leading cause of death for people between 6 and 27 years of age.

Figure 1
Leading Causes of Death of People of All Ages in the United States: 1998
(In thousands)



SOURCES: Diseases—U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, *National Vital Statistics Reports,* vol. 47, No. 25, October 1999. Transportation accidents—U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Motor vehicle collisions account for about 95 percent of transportation-related deaths and an even higher percentage of transportation injuries. Human behavior—such as alcohol and drug use, reckless operation of vehicles, failure to properly use occupant protection devices, and fatigue—is a major factor in a high proportion of crashes.

DOT has set specific targets for the next few years to improve transportation safety. These include goals to lower the U.S. commercial air carrier fatal crash rate by 80 percent by 2007, reduce highway fatalities by 20 percent by 2008, and reduce commercial truck-related fatalities by 50 percent by 2010. Specific safety initiatives for rail, transit, maritime, and pipelines are also in place.

Source

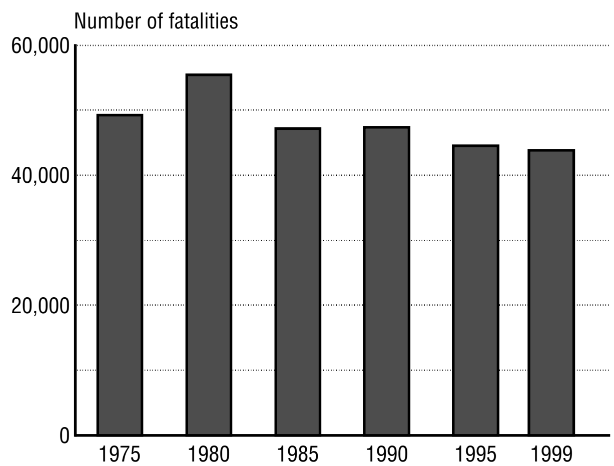
1. U.S. Department of Transportation, *1999 Strategic Plan* (Washington, DC: September 2000).

Transportation Fatalities: A Modal Picture

Over the last 25 years, fatalities on the nation's roads, rails, and waters and in the skies have declined (figure 1). Despite progress, transportation crashes and incidents claimed 43,873 lives in 1999, of which 41,611 involved highway vehicles. (The National Highway Traffic Safety Administration's early assessment of highway fatalities in 2000 is 41,800.) Occupants of passenger cars and light trucks (i.e., sport utility vehicles, vans and minivans, and pickup trucks) accounted for over 70 percent of the transportation fatalities in 1999; pedestrians, motorcyclists, bicyclists, and others involved in motor vehicle collisions accounted for most of the remaining deaths (table 1).

Of the 2,262 transportation fatalities in 1999 that did not involve highway vehicles, recreational boating and general aviation (e.g., private planes for individual and business use) together claimed the lives of 1,364 people. Commercial carriers (airlines, trains, waterborne vessels, and buses) accounted for slightly under 900 fatalities. Many of these were bystanders and others outside of vehicles.

Figure 1
Total Fatalities by All Modes of Transportation



NOTE: For 1975, 1980, and 1985 some double counting may be included. The double counting affects about 1 percent of the data and should not impact the trend shown in the chart.

SOURCE: Various sources as cited in U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Table 1
Distribution of Transportation Fatalities by Mode: 1999

Category	Number	Percent
Passenger car occupants	20,818	47.5
Light-truck occupants	11,243	25.6
Pedestrians struck by motor vehicles	4,906	11.2
Motorcyclists	2,472	5.6
Large-truck occupants	758	1.7
Pedalcyclists struck by motor vehicles	750	1.7
Recreational boating	734	1.7
General aviation	630	1.4
Trespassers on railroad property (excluding grade crossings)	478	1.1
Other and unknown motor vehicle occupants	457	1.0
Other nonoccupants struck by motor vehicles[1]	149	0.3
Heavy-rail transit (subway)	84	0.2
Waterborne transportation (nonvessel-related)	67	0.2
Bus occupants (school, intercity, and transit)	58	0.1
Grade crossings (not involving motor vehicles)	57	0.1
Waterborne transportation (vessel-related)	44	0.1
Railroad employees/contractors	43	0.1
Air taxi	38	0.09
Gas distribution pipelines	20	0.05
Light-rail transit	17	0.04
Air carriers	12	0.03
Commuter air	12	0.03
Transit buses (not related to accidents)[2]	11	0.03
Railroad[3]	9	0.02
Hazardous liquid pipelines	4	0.01
Gas transmission pipelines	2	<0.01
Total[4]	**43,873**	**100.0**
Redundant with above[5]		
Grade crossings, with motor vehicles	345	
Commuter rail (included in railroad)	95	
Transit buses (accident-related)	91	
Passengers on railroad trains	14	
Demand responsive transit (accident-related)	1	

[1] Includes all nonoccupant fatalities, except pedalcyclists and pedestrians.
[2] Includes incidents such as suicides, heart attacks, and shootings.
[3] Includes fatalities outside trains.
[4] Unless otherwise specified, includes fatalities outside the vehicle.
[5] Fatalities at grade crossings with motor vehicles are included under relevant motor vehicle modes. Commuter rail fatalities are counted under railroad. For transit bus and demand responsive transit accidents, occupant fatalities are counted under "bus" and nonoccupant fatalities are counted under "pedestrians," "pedalcyclists," or other motor vehicle categories.

SOURCES:
Air: National Transportation Safety Board, available at http://www.ntsb.gov/aviation, as of April 2000.
Highway: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (DOT HS 808 983) (Washington, DC: October 1999), table 4, and personal communication, Oct. 4, 1999.
Railroad: U.S. Department of Transportation, Federal Railroad Administration, *Railroad Safety Statistics, Annual Report 1999* (Washington, DC: August 2000), table 1-1.
Transit: U.S. Department of Transportation, Federal Transit Administration, *Safety Management Information Statistics* (Washington, DC: Annual issues).
Waterborne transportation: U.S. Department of Transportation, U.S. Coast Guard, Office of Investigations and Analysis, Compliance Analysis Division (G-MOA-2), personal communication, Apr. 13, 1999.
Recreational boating: U.S. Department of Transportation, U.S. Coast Guard, Office of Boating Safety, *Boating Statistics* (Washington, DC: Annual issues).
Pipeline: U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety, available at http://ops.dot.gov, as of June 28, 2000.

Transportation Fatality Rates

The more people travel, the greater the risk they incur. Thus, using the absolute numbers of fatalities to compare the safety of a given mode over time (table 1) can be misleading, since any change in the fatality numbers might be explained by a change in the amount of transportation activity. A clearer picture can be derived from exposure rates. Exposure rates are calculated by dividing the absolute numbers of fatalities (or other adverse outcome) by an activity measure, such as number of trips, number of miles traveled, or number of hours of vehicle operation.

Figure 1 shows fatality rates for selected modes for a time period of two decades or more. It is clear that safety in most modes has improved over the last 25 years. However, for several of the modes, the greatest improvement in fatality rates tended to occur in the earlier years of the period.

The activity measures used as denominators are not the same for all modes. For highway travel, exposure to risk is approximately proportional to distance traveled, hence the use of vehicle-miles as the denominator. For aviation, the greatest proportion of crashes occurs during takeoff and landing; hence risk is approximately proportional to the number of operations (measured as departures). Data on departures are not available for general aviation for recent years, so hours flown is used instead. For some means of travel, there are no good measures of the risks entailed. For example, while over 4,900 pedestrians were struck by motor vehicles and died in 1999, exposure measures are lacking because good data are not available for the amount of time, distances, or other circumstances of pedestrian travel.

Highway submodes show considerable improvement in fatality rates since 1975, when the federal government began to collect systematic national data from states. While all highway submodes show improved rates, there is much variation among them. Occupants of passenger cars and light trucks (including pickup trucks, vans, and sport utility vehicles) have much higher fatality rates than occupants of large trucks. Motorcycle riders have the highest fatality rate by far among the highway submodes. A large number of factors influence the difference in fatality rates. For example, the greater size and mass of large trucks serves to protect the occupants of these vehicles in crashes with smaller vehicles or less massive objects.

Many factors may interact to explain the decreasing fatality rates. For highway modes, promotion of safety belt, child safety seat, and motorcycle helmet usage, and measures to discourage drunk driving have all had a beneficial effect. So, too, have improvements in vehicle and highway design and greater separation of traffic. Finally, some of the decrease in transportation fatalities may be a consequence of better and prompter medical attention for victims of transportation crashes and accidents.

Table 1
Fatalities by Transportation Mode

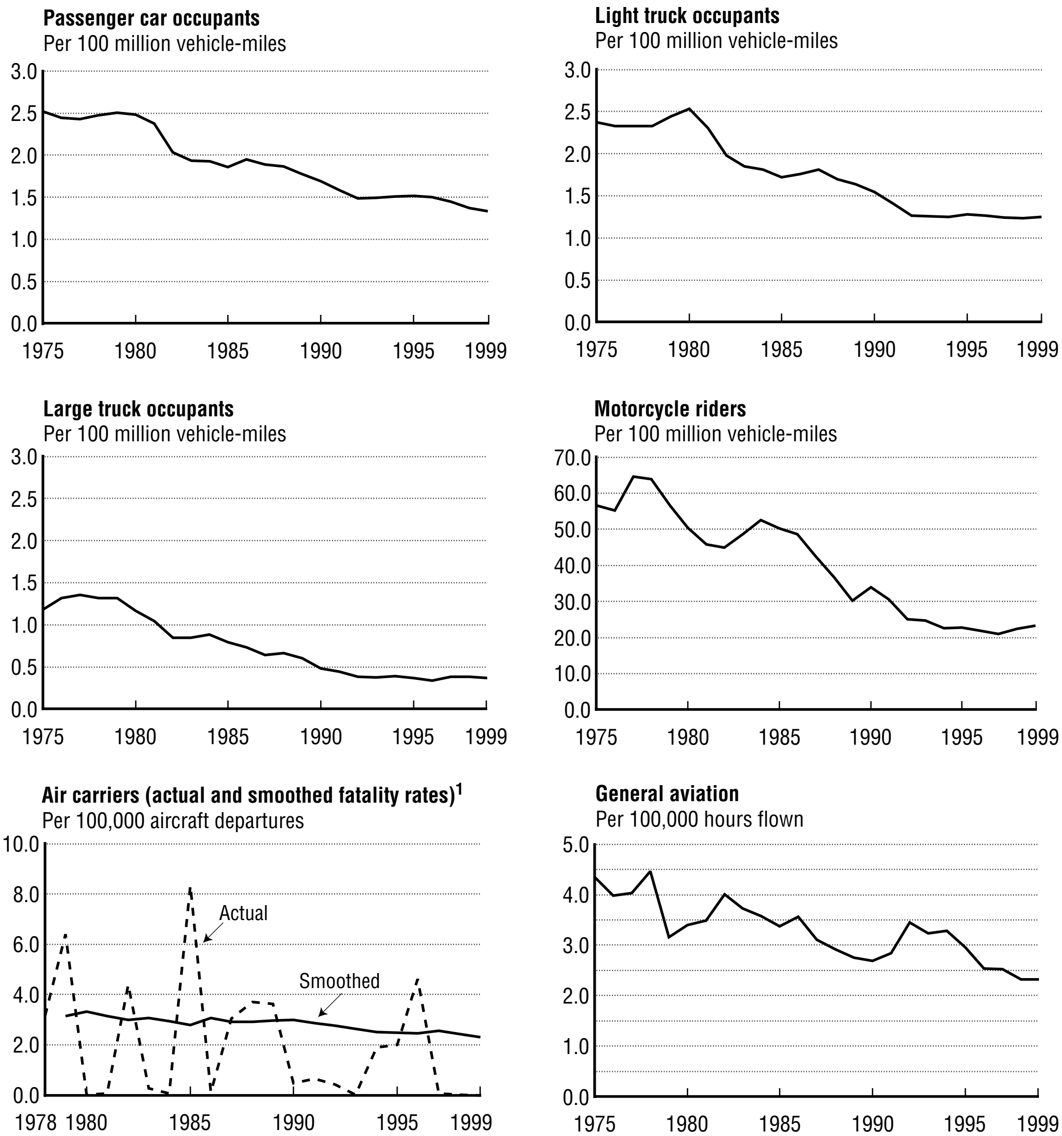
Year	Air carriers[1]	Commuter air[1]	On-demand air taxi[2]	General aviation[2]	Highway[3]	Rail[4]	Transit[5]	Waterborne[6]	Recreational boating	Gas and hazardous liquid pipeline
1975	124	28	69	1,252	44,525	575	N	573	1,466	15
1980	1	37	105	1,239	51,091	584	N	487	1,360	19
1985	526	37	76	956	43,825	454	N	261	1,116	33
1990	39	7	R51	R767	44,599	599	339	186	865	9
1995	168	9	52	734	41,817	567	274	183	829	21
1999	12	12	38	630	41,611	530	299	111	734	26
2000[7]	92	5	71	592	41,800	518	NA	NA	NA	38

[1] Large carriers operating under 14 CFR 121, all scheduled and nonscheduled service.
[2] All scheduled and nonscheduled service operating under 14 CFR 135 and all operations other than those operating under 14 CFR 121 and 14 CFR 135.
[3] Includes occupants of passenger cars, light trucks, large trucks, buses, motorcycles, other or unknown vehicles, nonmotorists, pedestrians, and pedalcyclists. Motor vehicle fatalities at grade crossings are counted here.
[4] Includes fatalities resulting from train accidents, train incidents, and nontrain incidents (e.g., fires in railroad repair sheds). Thus, the data cover many nonpassengers, making comparisons to other modes difficult. Motor vehicle fatalities at grade crossings are counted in the highway column. Figures include Amtrak.
[5] Includes motor bus, commuter rail, heavy rail, light rail, demand responsive, van pool, and automated guideway. Some transit fatalities are also counted in other modes. Reporting criteria and source of data changed between 1989 and 1990. Starting in 1990, fatality figures include those occurring throughout the transit station, including nonpatrons. Fatalities include those arising from incidents involving no moving vehicle (e.g., falls on transit property). Thus, the data cover many nonpassengers, making comparisons to other modes difficult. Prior to 1998, only data from directly operated transit services were reported. Beginning in 1998, fatality data for purchased transit service, such as paratransit services, were included.
[6] Includes fatalities related to vessel and nonvessel casualties (e.g., an individual who falls overboard and drowns).
[7] All 2000 numbers are preliminary.

KEY: N = data are nonexistent; NA = not available; R = revised.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Figure 1
Fatality Rates for Selected Modes



[1] For air carriers, the data were dampened, or smoothed, to reduce the month-to-month fluctuations. This dampening was performed using an exponential smoothing model, with a weight of 0.95. Departure data, and hence the denominator of the rates, are not strictly comparable between pre- and post-1977 eras.

SOURCE: Various sources, as cited in U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Highway Crash Characteristics

The overwhelming majority of highway fatalities occur as a result of single-vehicle crashes and crashes involving two vehicles. For example, in 1999, 41 percent of traffic crash fatalities were vehicle occupants (including drivers) killed in single-vehicle crashes and 38 percent of fatalities occurred as a result of two-vehicle crashes (table 1). Crashes in which three or more vehicles were involved caused only 7 percent of traffic fatalities in 1999. (Some preliminary highway crash statistics are available from the National Highway Traffic Safety Administration (NHTSA). See box.)

An average of one-third of all motor vehicle crash fatalities nationwide result from single vehicle run-off-the-road (ROR) crashes, and two-thirds of these ROR fatalities occur in rural areas. It has been estimated that 40 to 60 percent of these crashes are due to driver fatigue, drowsiness, or inattention. The Federal Highway Administration recommends the use of rumble strips along the roadway shoulder as an effective way to reduce these incidents. The noise produced by vehicle tires on these rumble strips warns drivers that they are leaving the roadway. Studies of the effectiveness of shoulder rumble strips indicate that they can reduce the overall rate of ROR crashes between 15 and 70 percent [1]. In the future, the development of in-vehicle technologies that detect driver drowsiness and inattention and suitably warn the driver may further reduce the incidence of such crashes.

Traffic crashes between light trucks or vans and passenger cars is of increasing concern. Since the early 1980s, the category of light trucks and vans (LTVs) has grown dramatically (figure 1).

Table 1
Total Fatalities in Motor Vehicle Crashes by Type of Crash: 1999

Type of crash	Number
Drivers/occupants killed in single-vehicle crashes	17,052
Drivers/occupants killed in two-vehicle crashes	15,690
Drivers/occupants killed in crashes of three-vehicles or more	3,064
Pedestrians killed in single-vehicle crashes	4,488
Bicyclists killed in single-vehicle crashes	714
Pedestrians/bicyclists killed in multiple-vehicle crashes	454
Others/unknown	149
Total	**41,611**

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, Fatality Analysis Reporting System 1999, available at http://www-fars.nhtsa.dot.gov, as of Nov. 15, 2000.

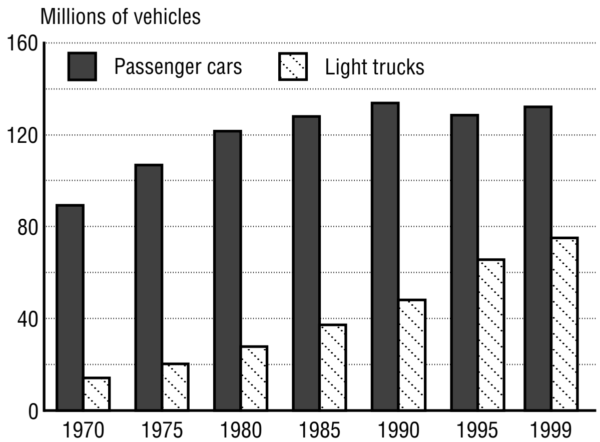
National Highway Traffic Safety Administration Early Assessment 2000 Motor Vehicle Data

In March 2001, the National Highway Traffic Safety Administration (NHTSA) released its early assessment estimates for motor vehicle traffic crashes in 2000 and the resulting injuries and fatalities. These early assessment numbers, based on NHTSA's Fatality Analysis Reporting System (FARS) and the National Automotive Sampling System General Estimates System (NASS GES), estimate that highway fatalities increased by 0.5 percent from 1999 to 2000, while injuries decreased by about 0.4 percent.

However, NHTSA cautions that its early assessment estimates are based on data that are incomplete or preliminary. For example, both FARS and NASS GES data for the earlier months of 2000 are likely to be more complete than data for later months. Therefore, fatality and injury estimates for the year were obtained by combining the more complete data from earlier months with data for later months that were extrapolated from 1999 data. For FARS, the degree of completion of 2000 data varies by state. NASS GES uses extrapolated data for the final three months of the year. NHTSA also used projected vehicle-miles of travel from the Federal Highway Administration to estimate fatality rates.

Where appropriate, NHTSA early assessment data are presented in sections of this chapter.

Figure 1
Growth in the Number of Passenger Cars and Light Trucks



SOURCES: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995*, FHWA-PL-97-009 (Washington, DC: July 1997), table MV-201.
____. *Highway Statistics 1999* (Washington, DC: 2000).

LTVs include pickup trucks, vans, minivans, truck-based wagons, and sport utility vehicles (SUVs). Differences in vehicle size, weight, and geometry in multivehicle crashes can put occupants of passenger cars at greater risk in a crash with a light-duty truck than in a crash involving two or more passenger cars. For example, a study done for NHTSA by the University of Michigan Transportation Research Institute shows that when an SUV strikes a passenger car in a frontal crash, occupants of the car are almost twice as likely to have fatal injuries as the occupants of the SUV. In frontal collisions between two cars of similar weight, the ratio of deaths is 1:1. The same study found that, in side impact crashes, SUVs are more injurious as a striking vehicle than are passenger cars. For example, when SUVs strike passenger cars on the left side, the risk of death to the car driver can be 25 times greater than the risk to the SUV occupant. However, in the same type of crash involving two cars, the risk of death to the driver of the car being struck is only 10 times greater than the occupant of the other car [2].

Another issue related to SUVs is their propensity to rollover during certain steering maneuvers. SUVs are constructed with higher ground clearance for occasional offroad use and, thus, have a higher center of gravity. SUV height, along with other factors, contributes to the average rate of 98 rollover fatalities per million registered vehicles compared with 44 such fatalities per million registered vehicles for all other light vehicle types [3]. Also, in fatal crashes SUVs are twice as likely to rollover as compared with passenger cars, increasing the risk of occupant ejection, fatality, or injury [2].

Sources

1. U.S. Department of Transportation, Federal Highway Administration, *Effectiveness of Rumble Strips,* available at http://safety.fhwa.dot.gov, as of Feb. 1, 2001.
2. U.S. Department of Transportation, National Highway Traffic Safety Administration/University of Michigan Transportation Research Institute, *Fatality Risks in Collisions Between Cars and Light Trucks* (Washington, DC: September 1998).
3. U.S. Department of Transportation, Office of the Assistant Secretary of Public Affairs, *News Release: DOT Requires Upgraded Rollover Warning Label for Sport Utility Vehicles,* Mar. 5, 1999, available at http://www.nhtsa.dot.gov/nhtsa/announce/press/1999/1999press.dbm, as of Jan. 31, 2001.

Economic Costs of Motor Vehicle Crashes

According to the National Highway Traffic Safety Administration (NHTSA), motor vehicle crashes cost society $4,800 per second. Deaths, injuries, and property damages due to these crashes are not only a major cause of personal suffering and financial loss to the victims, their families, and friends, but also to society at large. NHTSA estimates that in 1994 the economic cost of motor vehicle crashes was $150.5 billion. Included in this amount are lost productivity, legal and court costs, medical and emergency service costs, insurance administration costs, travel delay, property damage, and workplace losses [1]. (NHTSA expects to have updated economic cost data in mid-2001.)

Motor vehicle crashes affect both the individual crash victims and society as a whole in a number of ways. The cost of medical care, for example, is borne by the individual through payments for expenses not covered by insurance and by society through higher insurance premiums and the diversion of medical resources away from other needs. Considerable costs are also associated with the loss of productivity when an individual's life is claimed at an early age or when a crash results in a disabling injury.

Of the total economic loss of $150.5 billion, medical costs were responsible for $17 billion, property losses for $52.1 billion, lost productivity (both market and household) was $54.7 billion, and other costs were $26.6 billion (figure 1). The largest single cost component is property damage, which accounted for over one-third of total economic costs. The high cost of property damage is primarily a function of the large number of minor crashes in which injury is either insignificant or nonexistent.

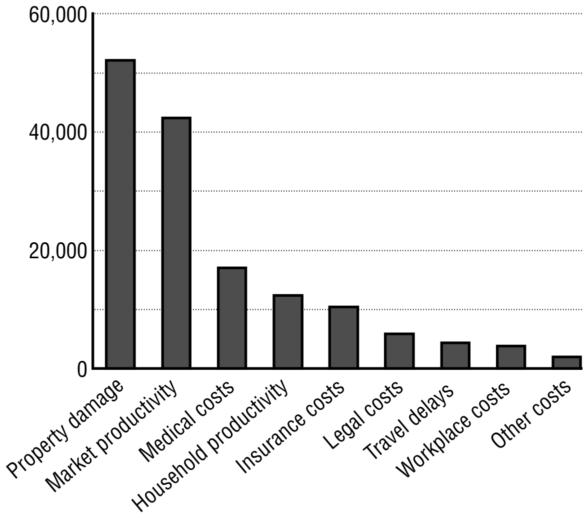
Alcohol use is one of the major causes of motor vehicle crashes. Historically, almost half of all fatalities have occurred in crashes where a driver or pedestrian had been drinking. In 1994, alcohol was involved in crashes that accounted for 30 percent of all economic costs, with over 78 percent of these costs involving crashes where a driver or pedestrian was legally intoxicated [1].

Speeding is another prevalent factor contributing to traffic crashes. The economic cost to society of speeding-related crashes is estimated to be $28 billion per year. In 1999, speeding was a contributing factor in 30 percent of all fatal crashes, and 12,628 lives were lost in speeding-related crashes [2].

Sources

1. U.S. Department of Transportation, National Highway Traffic Safety Administration, *The Economic Cost of Motor Vehicle Crashes, 1994,* 1996, available at http://www.nhtsa.dot.gov/people/economic, as of Nov. 27, 2000.
2. ____. *Traffic Safety Facts 1999: Speeding,* available at http://www.nhtsa.dot.gov/people/ncsa, as of Nov. 27, 2000.

Figure 1
Components of Economic Costs of Vehicle Crashes: 1994



SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, *The Economic Cost of Motor Vehicle Crashes, 1994* (Washington, DC: 1996).

Highway Crashes on Rural and Urban Roads

Two- and three-lane rural roads make up the majority of the highway system in the United States. If Interstate highways are excluded, these rural roads represent four times the highway mileage of urban roads in the U.S. highway system [1].

In 1999, approximately 60 percent of fatal highway crashes occurred on rural roads, with almost 79 percent occurring on rural roads and rural Interstates with speed limits of 55 mph or more (table 1). When rural and urban Interstates are excluded, 84 percent of higher speed crashes occurred on rural roads. Regardless of the speed limit, 13 percent of all fatal crashes in rural areas occurred on Interstates; 15 percent were on urban Interstates [2].

Road conditions contribute to the greatest proportion of fatal crashes in rural areas. In particular, two-way traffic on roads posted for high speed limits is a concern. Rural drivers often must deal with challenging road geometry (e.g., width, alignment, and sight distances) and challenging geography (e.g., steep grades and mountain passes). Adverse weather can further affect rural road conditions and sparse and patchy telecommunications infrastructure can slow emergency response time when a crash occurs. On average, emergency response time to highway crashes in rural areas is 1.5 times greater than in urban areas, however, response-time data on a large percentage of crashes are not available (table 2).

Sources

1. Transportation Research Board, National Cooperative Highway Research Program, *Accident Mitigation Guide for Congested Rural Two-Lane Highways,* Report 440 (Washington, DC: 2000).
2. U.S. Department of Transportation, National Highway Traffic Safety Administration, Fatality Analysis Reporting System database, 1999, 2000, available at www.nhtsa.dot.gov/people/ncsa/fars.html, as of January 2001.

Table 1
Fatal Crashes by Speed Limits and Type of Road: 1999

Speed limit	Rural			Urban				
	Interstate	Principal arterial	Other	Interstate	Principal arterial	Other	Unknown	Total
30 mph or less	2	61	987	11	28	2,802	94	**3,985**
35 or 40 mph	15	181	1,899	39	114	4,383	129	**6,760**
45 or 50 mph	35	612	3,085	121	208	3,046	187	**7,294**
55 mph	186	2,510	8,629	684	368	1,308	229	**13,914**
60 mph or higher	2,971	1,846	1,535	1,430	580	197	14	**8,573**
No posted limit	5	14	89	1	0	16	9	**134**
Unknown	22	56	368	61	56	362	26	**951**
Total	**3,236**	**5,280**	**16,592**	**2,347**	**1,354**	**12,114**	**688**	**41,611**

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, Fatality Analysis Reporting System database, 2000.

Table 2
Average Emergency Medical Service (EMS) Response Time for Rural and Urban Fatal Crashes: 1998
(In minutes)

Event	Rural	Unknown	Urban	Unknown
Time of crash to EMS notification	6.77	37%	3.62	46%
EMS notification to EMS arrival at crash scene	11.36	35%	6.26	47%
EMS arrival at crash scene to hospital arrival	36.28	67%	26.63	72%
Time of crash to hospital arrival[1]	51.78	68%	35.46	71%

[1] Not a total of the above categories, as separate records are kept for this category.

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (Washington, DC: 1999).

Alcohol-Related Highway Crashes

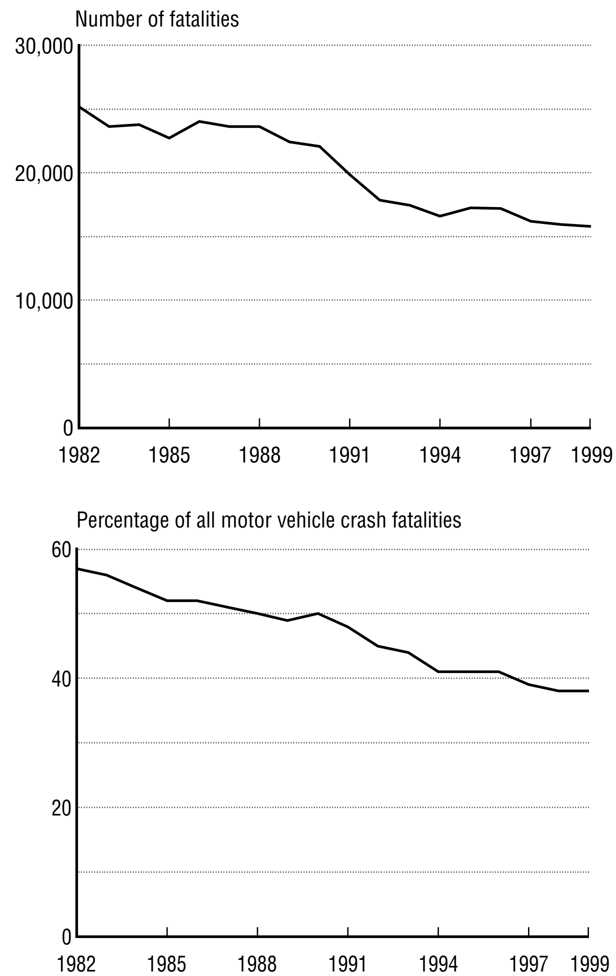
In 1999, 38 percent of the 41,611 highway fatalities were related to alcohol. In 1982, the first year for which data are available, 25,165 people died in alcohol-related motor vehicle crashes—57 percent of all highway fatalities. By 1999, alcohol-related fatalities had dropped to 15,787 (figure 1), and the National Highway Traffic Safety Administration's early assessment for 2000 shows 16,068 such fatalities. The U.S. Department of Transportation has a goal of reducing alcohol-related fatalities to no more than 11,000 by 2005 [3].

Improved state and local education programs, stricter law enforcement, adoption of a 0.08 blood alcohol concentration (BAC) by 18 states, higher minimum drinking ages, more stringent license revocation laws, and reduced tolerance for drinking and driving have all been cited as factors in reducing alcohol-related deaths. Despite improvements, 18 percent of passenger car drivers, 20 percent of light truck drivers, 1 percent of large truck operators, and 31 percent of motorcycle operators involved in fatal crashes in 1998 were legally intoxicated with a BAC of 0.10 or greater [4].

In 1999, the highest intoxication rates in fatal crashes involved drivers between 21 and 24 years of age (figure 2). In addition, the highest arrest rates for drunken driving were also for drivers in this age group [3]. Between 1989 and 1999, intoxication rates decreased for drivers of all age groups involved in fatal crashes. The largest decreases were for those drivers aged 16 to 20 (30 percent) and drivers over 64 (29 percent) [2].

Alcohol-related fatalities declined more quickly in the 1980s than in the 1990s. Between 1994 and 1999, the percentage of highway fatalities attrib-

Figure 1
Alcohol-Related Fatalities in Motor Vehicle Crashes: 1982–1999



SOURCES: 1982–1998—U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (Washington, DC: 1999).
1999—____. Fatality Analysis Reporting System database, 1999, 2000.

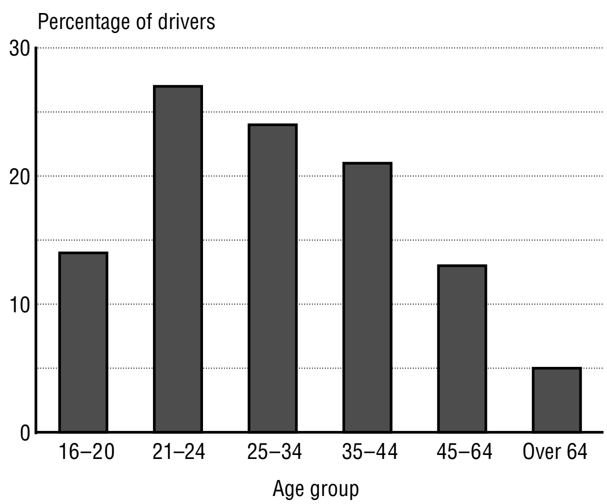
uted to alcohol declined by only 3 percent—from 41 percent to 38 percent. Moreover, while alcohol-related fatalities among drivers 16 to 20 years of age decreased, alcohol consumption in this age group increased every year from 1993 to 1999 [3].

Fatality rates vary by state (see map on next page). It is illegal in every state and the District of Columbia to drive a motor vehicle while under the influence of alcohol. In addition, every state except Massachusetts has laws that make it illegal for a person to drive a motor vehicle with a specific amount of alcohol in his or her blood. As of October 2000, 31 states defined intoxicated driving as 0.10 BAC—the level at which a person's blood contains 1/10th of 1 percent of alcohol. Eighteen states and the District of Columbia have enacted 0.08 BAC laws [1].

In 2000, Congress enacted legislation that provides strong encouragement for states to adopt the 0.08 BAC [6]. States have until October 1, 2003, to pass the stricter limit or face the withholding of 2 percent of their federal highway construction funds. After 2003, states that fail to pass the 0.08 BAC will lose an additional 2 percent of their federal funding every year. By October 1, 2006, and each year thereafter, states that still have not adopted 0.08 BAC laws will lose 8 percent of their funding [5].

Highway safety advocates have encouraged states to take a systems approach to reducing drunk driving. Some states have enacted a combination of measures. In addition to 0.08 BAC limits, such measures include stringent license revocation laws (under which a person deemed to be driving under the influence has his or her driving privileges suspended or revoked), comprehensive screening and treatment programs for alcohol offenders, vehicle impoundment, and zero tolerance BAC and other laws for youths [7].

Figure 2
Intoxicated Drivers by Age: 1999
(0.10 BAC or greater)

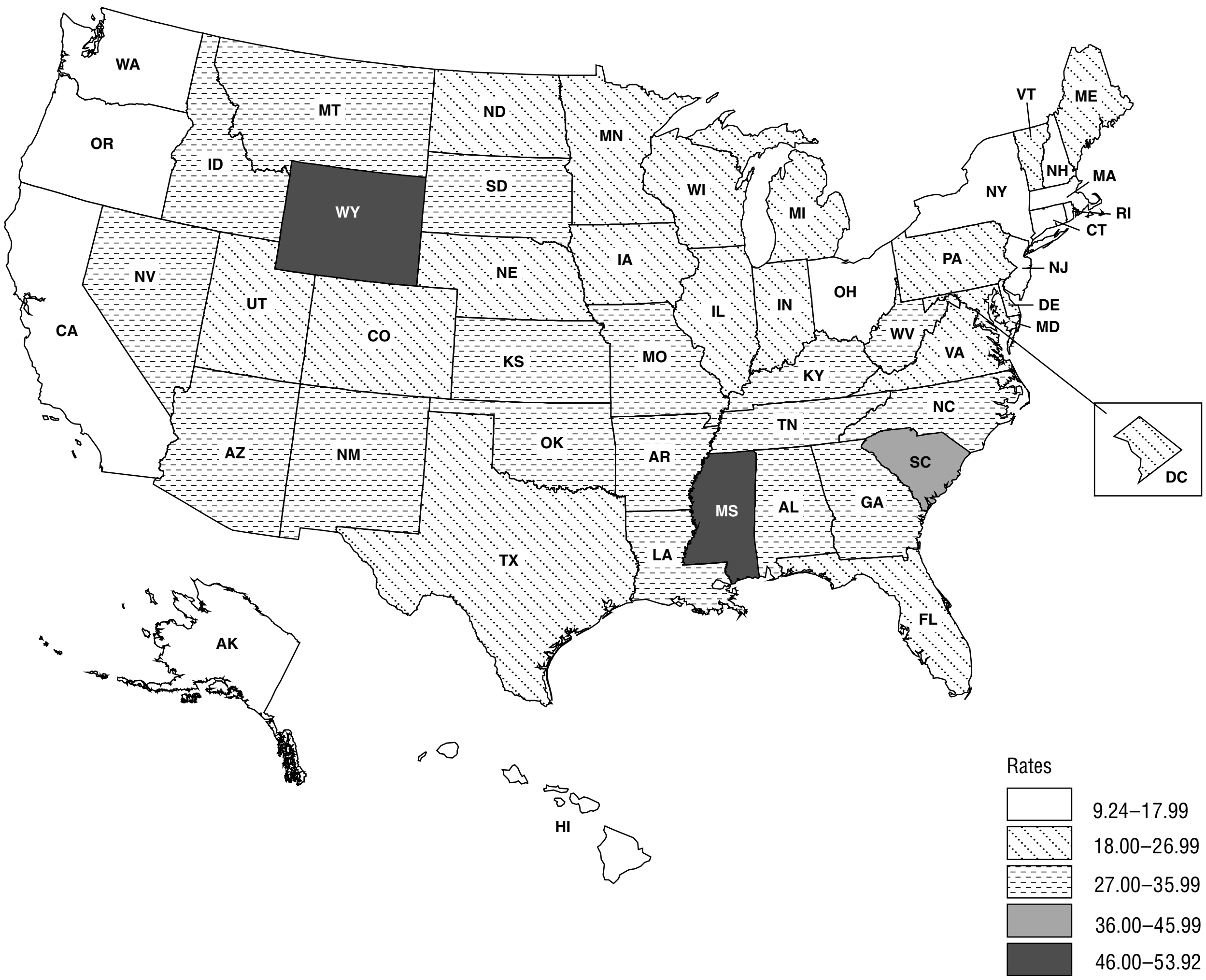


SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999* (Washington, DC: 2000).

Sources

1. Mothers Against Drunk Driving (MADD), "President Clinton Signs Federal 0.08 BAC Drunk Driving Law," press release, available at http://www.madd.org/media/pressrel, as of Oct. 23, 2000.
2. U.S. Department of Justice, Bureau of Justice Statistics, *More Than 500,000 Drunk Drivers on Probation or Incarcerated* (Washington, DC: 1999), also available at http://www.ojp.usdoj.gov/bjs/pub/press/dwiocs.pr, as of Oct. 27, 2000.
3. U.S. Department of Transportation, *FY 1999 Performance Report/FY 2001 Performance Plan* (Washington, DC: 2000), also available at http://www.dot.gov/ost, as of Oct. 23, 2000.
4. U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (Washington, DC: 1999), also available at http://www.nhtsa.dot.gov/people/ncsa, as of Oct. 23, 2000.
5. ____. "Congress Agrees to 0.08% Blood Alcohol as the Legal Level for Impaired Driving," *NHTSA Now Newsletter,* Oct. 16, 2000.
6. U.S. Department of Transportation, Office of Public Affairs, "Statement by U.S. Transportation Secretary Rodney Slater Upon Signing of Transportation Appropriations Act by President Clinton," Oct. 23, 2000.
7. U.S. General Accounting Office, Resources, Community, and Economic Development Division, *Highway Safety: Effectiveness of State 0.08 Blood Alcohol Laws* (Washington, DC: June 1999).

Alcohol-Related Motor Vehicle Fatality Rates per 100,000 Licensed Drivers: 1999



SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999* (Washington, DC: 2000).

Occupant Protection: Safety Belts, Air Bags, and Child Restraints

The National Highway Traffic Safety Administration (NHTSA) estimates that, in 1999, safety belts saved the lives of 11,197 passenger vehicle occupants over 4 years old (figure 1). NHTSA also estimates that 20,750 lives could have been saved that year if all passenger vehicle occupants aged 4 and older wore safety belts [1].

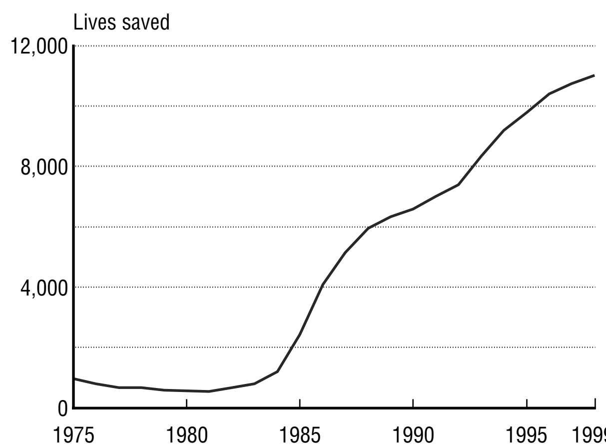
The number of lives saved has increased dramatically since 1984 when states began to enact safety belt laws. A June 2000 NHTSA survey showed that 71 percent of passenger vehicle occupants used safety belts [4]. Usage rates differ noticeably among the states based on how the safety belt laws are enforced (see map on safety belt use rates on page 56). There are three levels of enforcement: primary enforcement allows a police officer to stop and cite someone for not wearing a safety belt; secondary enforcement allows a police officer to cite someone for not wearing a safety belt only if they have been stopped for some other infraction; and no enforcement [1]. Usage in the 17 states with primary enforcement was 77 percent as opposed to 63 percent in the 33 states with secondary enforcement laws (see map on safety belt use laws on page 57). Safety belt usage in New Hampshire, which does not require adults to wear safety belts, was 56 percent.

Beginning in September 1997 (model year 1998), all new passenger vehicles were required to have driver and passenger air bags. The following year, the same requirement was applied to light trucks. NHTSA estimated that, as of 1999, more than 91 million air-bag-equipped passenger vehicles were on the road, including 65 million with dual air bags. In 1999, an estimated 1,263 lives were saved by air bags. From 1987 through 1999, an estimated total of 4,969 lives were saved [1].

According to NHTSA, air bags, combined with safety belts, offer the most effective safety protection available today for passenger vehicle occupants. Air bags are supplemental protection and are designed to deploy in moderate-to-severe frontal crashes. Adults and some children riding in front seats have been injured or killed by air bags inflating in low severity crashes. While far more lives have been saved by air bags than have been lost, since 1990, 168 deaths from injuries caused by air bags have occurred. This includes 99 children riding in the front seat [2]. If children under the age of 13 ride in the back seat of passenger vehicles and are secured by appropriate restraint systems, risk of injuries or death from air bags can be avoided [1].

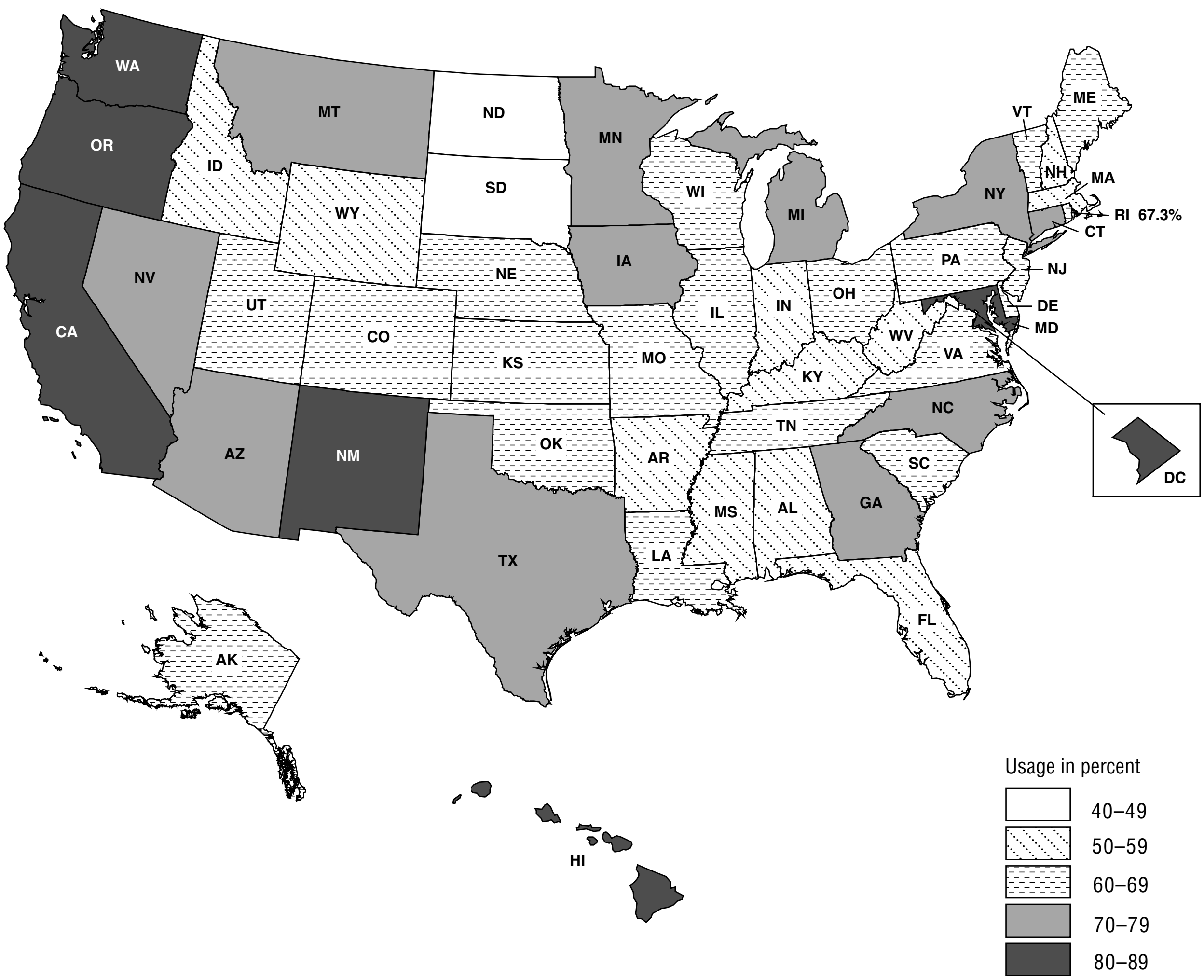
In 1999, 543 passenger vehicle occupant fatalities were reported among children less than 5 years of age [3]. NHTSA estimated that in 1999, use of child restraint systems saved the lives of

Figure 1
Estimated Number of Lives Saved Each Year by Use of Safety Belts: 1975–1999



SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration.

Safety Belt Use Rates: 1999[1]

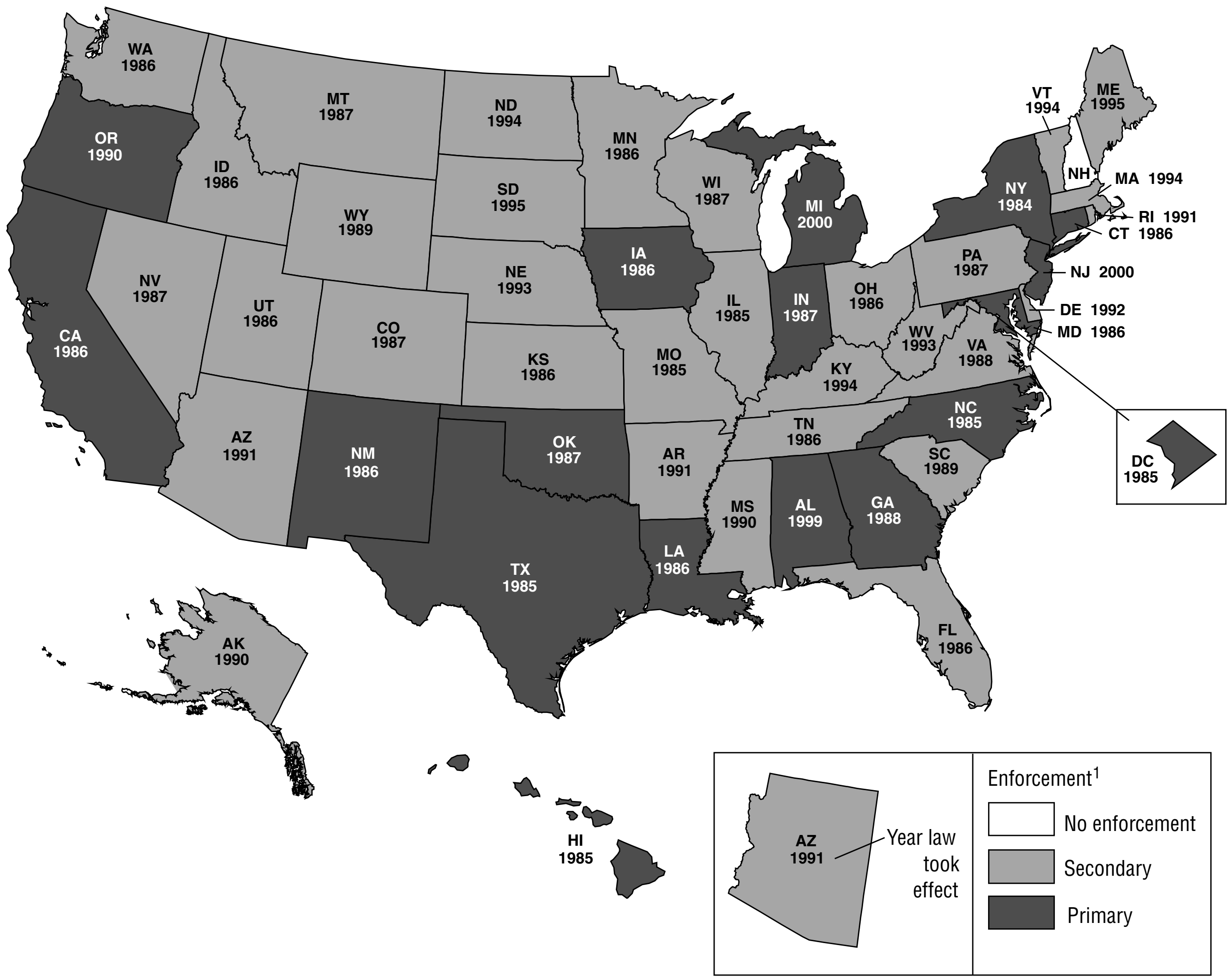


[1] Maine, New Hampshire, South Dakota, and Wyoming data are for 1998 from U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (Washington, DC: 1999).

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, “Research Note: 1999 State Shoulder Belt Use Survey Results,” October 2000.

307 children under the age of 5. An additional 162 lives could have been saved—for a total of 469—if every child under age 5 had been properly restrained in a child safety seat. From 1975 through 1999, an estimated 4,500 lives were saved by child restraints [1].

Type of Safety Belt Use Laws, by State: As of 2000



[1] Primary enforcement allows police officers to stop vehicles and write citations whenever they observe violations of safety belt laws. Secondary enforcement permits police officers to write a citation only after a vehicle is stopped for some other traffic violation.

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, "State Highway Safety Laws: Enforcement Provisions of Safety Belt Use," Aug. 1, 2000.

Sources

1. U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999: Occupant Protection* (Washington, DC: 2000).
2. ____. *Air Bag Fatalities and Serious Injury Report* (Washington, DC: 2000), also available at http://www.nhtsa.dot.gov/people/ncsa, as of Oct. 25, 2000.
3. ____. *Early Assessment of 1999 Crashes, Injuries, and Fatalities* (Washington, DC: 2000), also available at http://www.nhtsa.dot.gov/people/ncsa, as of Oct. 25, 2000.
4. ____. "Research Note: Observed Safety Belt Use from December 1999 and June 2000," November 2000.

Tire Recalls

In 2000, several tire manufacturers recalled a total of 14.4 million tires in use in the United States due to a variety of defects. Of these, in August 2000 the Bridgestone/Firestone Corporation recalled all but about 12,500[1] tires prone to tread separation [5]. By December 2000, the tires had been linked to highway crashes resulting in nearly 150 deaths and more than 500 injuries since the early 1990s. Although the tires are found on a variety of vehicles, most of the tires in question were original equipment on Ford vehicles, primarily the Explorer sport utility vehicle. By the end of 1999, the National Highway Traffic Safety Administration (NHTSA) had received 46 reports over 9 years about incidents involving these tires. However, the number of complaints escalated rapidly after news reports dramatized the question of the tires' safety—by December 2000, NHTSA had received over 4,000 complaints [4].

Accidents involving Firestone tires were also reported in the Middle East and Latin America. Ford replaced Firestone tires on Explorers in Saudi Arabia and Venezuela because of tread separation problems [2]. Auto safety advocates and many lawmakers contend that Firestone and Ford should have reported the overseas tire problems to NHTSA even though they were not required to do so [1].

In response to the problems brought to light by the tire recall, Congress enacted legislation in late 2000—the Transportation Recall Enhancement, Accountability and Documentation (TREAD) Act—that gives NHTSA additional authority to require manufacturers to report defects that first appear in vehicles or equipment in foreign countries. The TREAD Act also calls on NHTSA to upgrade tire safety standards and gives the agency greater authority to obtain lawsuit data to help identify trends that might indicate potential defects. The additional authority granted to NHTSA is expected to strengthen the agency's hand in its oversight of the industry by enhancing not only its enforcement capability but also its ability to collect industry data [3].

[1] Firestone estimated that approximately 6.5 million of the recalled ATX, ATX II, and Wilderness AT tires manufactured at the company's Decatur, Illinois, plant were still on the road.

Sources

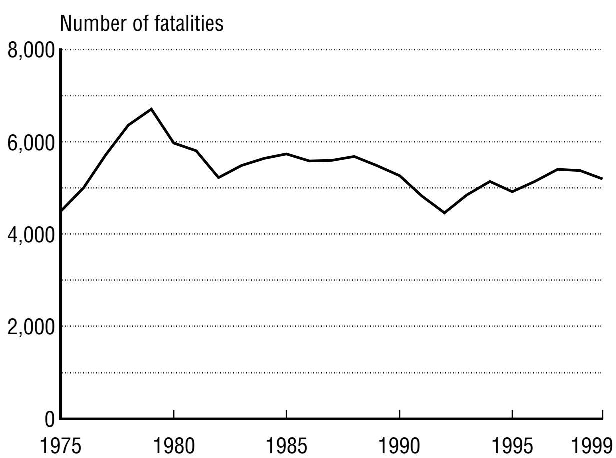
1. *Congressional Quarterly Weekly,* "House Panel Spurns Industry Objections, Approves Potential Criminal Penalties For Misleading Regulators on Auto Safety," No. 2279, Sept. 30, 2000.
2. Nasser, Jac, President, Ford Motor Co., testimony before the Committee on Commerce, Science, and Transportation, United States Senate, Sept. 12, 2000.
3. National Highway Traffic Safety Administration, *Now Newsletter,* Dec. 11, 2000, available at http://www.nhtsa.dot.gov, as of Jan. 31, 2001.
4. National Highway Traffic Safety Administration, Associate Administrator for Safety Assurance, Recall Analysis Division, Consumer Advisory, available at http://www.nhtsa.dot.gov/hot/firestone/index.html, as of Jan. 31, 2001.
5. _____. personal communication, Jan. 31, 2001.

Large Trucks

In 1999, 5,362 people were killed in crashes involving large trucks. The number of fatalities has varied from a low of 4,462 in 1992 to a high of 6,702 in 1979 (figure 1). (National Highway Traffic Safety Administration early assessment data show 5,307 fatalities in large truck crashes in 2000.) The number of drivers and occupants of large trucks killed in crashes has declined since the late 1970s, when fatalities averaged about 1,200, compared with about 700 in the 1990s. The overwhelming majority of people killed in large truck collisions—86 percent in 1999—were occupants of other vehicles or nonmotorists [1]. In two-vehicle crashes involving a large truck and a passenger vehicle, driver-related crash factors were cited by police officers at the scene for 26 percent of the truck drivers involved and for 82 percent of the passenger vehicle drivers. Table 1 shows the percent of crashes in which either the large-truck driver or the passenger-vehicle driver or both were cited for one or more of the top 10 factors identified as primary causes of crashes.

Large truck safety issues have received increased attention in recent years. In 1999, Congress passed the Motor Carrier Safety Improvement Act, which created the Federal Motor Carrier Safety Administration within the U.S. Department of Transportation. Among other provisions, the legislation calls for increased roadside inspections, compliance reviews and enforcement actions, improvements in safety data, and additional research into crash causes. About 25 percent of the over 2.2 million motor carrier vehicles inspected in 1999 were taken out of service (figures 2 and 3).

Figure 1
Fatalities in Large Truck Crashes: 1975–1999



SOURCES: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999* (Washington, DC: 2000), table 11.
____. Fatality Analysis Reporting System database, 1999.

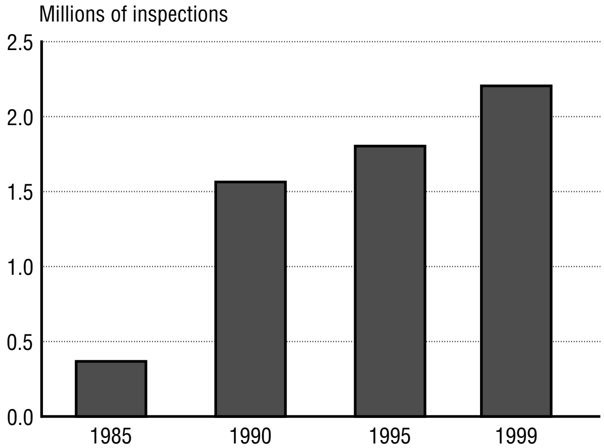
Table 1
Driver-Related Factors Cited in Two-Vehicle Fatal Crashes Between Large Trucks and Passenger Vehicles: 1998

Top 10 factors cited	Large trucks	Passenger vehicles
Failure to yield right-of-way	5.3%	20.3%
Ran off road/out of traffic lane	4.8%	27.8%
Driving too fast	3.8%	14.9%
Failure to obey traffic devices	3.0%	12.1%
Inattentive	2.7%	9.8%
Erratic/reckless driving	1.6%	5.1%
Manslaughter, homicide	1.5%	1.3%
Following improperly	1.4%	2.1%
Making improper turn	1.0%	2.6%
Vision obscured by weather	0.9%	1.7%

NOTES: 1998 is the most recent year for which data are available. Number of drivers involved in two-vehicle, large truck/passenger car crashes = 2,740.

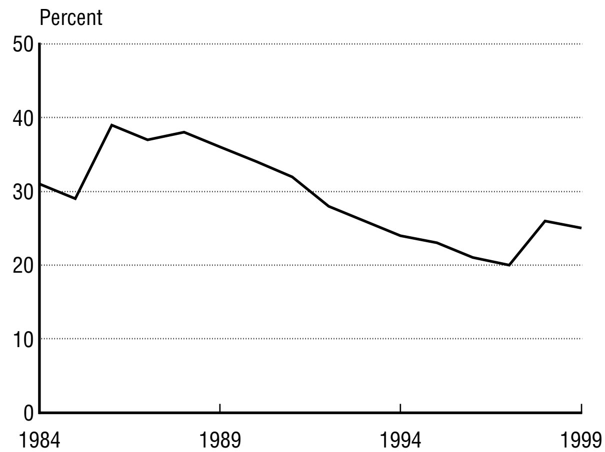
SOURCE: U.S. Department of Transportation, Federal Motor Carrier Safety Administration, *Large Truck Crash Profile: The 1998 National Picture* (Washington, DC: January 2000).

Figure 2
Motor Carrier Vehicle Inspections



SOURCE: U.S. Department of Transportation, Federal Motor Carrier Safety Administration, Motor Carrier Inspection Database.

Figure 3
Percentage of Vehicle Inspections in which the Vehicle is Taken Out of Service: 1984–1999



SOURCE: U.S. Department of Transportation, Federal Motor Carrier Safety Administration, Motor Carrier Inspection Database.

Source

1. U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999: Large Trucks* (Washington, DC: 1999).

Bicycles

In 1999, 750 bicyclists were killed in crashes with motor vehicles—a 25 percent reduction since 1975 (figure 1). (The National Highway Traffic Safety Administration's early assessment of bicycle fatalities for 2000 is 738.) While bicycle fatalities have declined, the U.S. Department of Transportation's Nationwide Personal Transportation Survey shows that bicycle trips more than doubled—from 1.3 billion to 3.3 billion trips between 1977 and 1995 [2].[1]

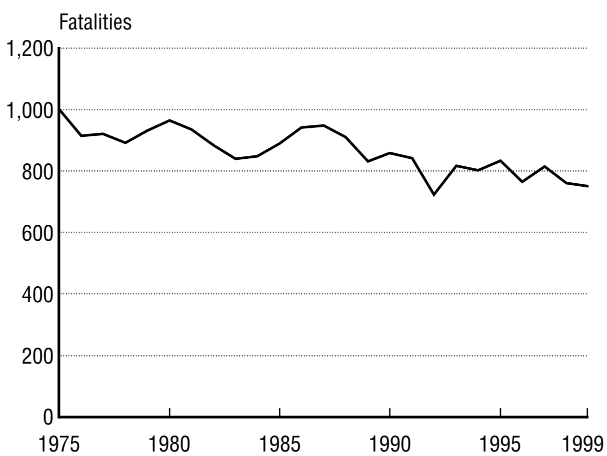
Exposure data for bicycling are limited, which makes it difficult to make statements about changes in risk over time or how risk profiles are affected by different behaviors. For example, it is notable that 28 percent of bicyclists killed in traffic crashes in 1999 were 15 years old or younger, a large decrease compared with the 1975 figure of 68 percent (figure 2). However, this change may be the result of an increase in bicycling by adults, a decrease by children, or a change in their relative safety rates.

In 1999, 64 percent of bicycle fatalities occurred in urban areas, with 70 percent of the fatalities arising at nonintersection locations. About 37 percent of bicycle fatalities occurred between the hours of 5:00 p.m. and 9:00 p.m., and 34 percent happened during the months of July, August, and September. Additionally, males accounted for 88 percent of the bicycle fatalities and 82 percent of those injured.

Alcohol is involved in about one-third of traffic crashes resulting in the death of a bicyclist. The bicyclist was intoxicated in 22 percent of these fatalities [6].

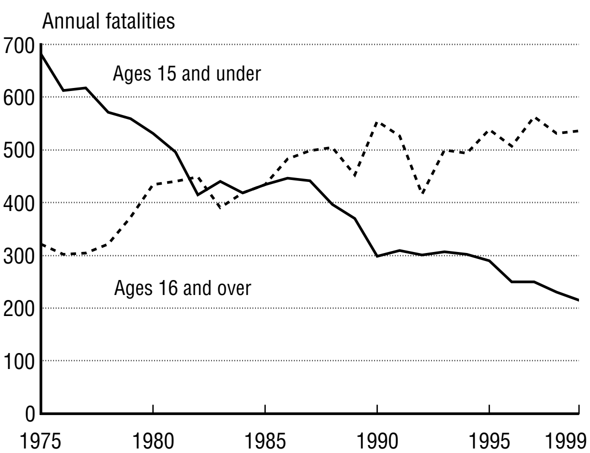
[1] 1995 data are the latest available.

Figure 1
Bicycle Fatalities in Motor Vehicle Crashes: 1975–1999



SOURCES: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (Washington, DC: 1999).
____. *Traffic Safety Facts 1999: Pedalcyclists* (Washington, DC: 2000).
____. Fatality Analysis Reporting System (FARS) database, 1999.

Figure 2
Bicycle Fatalities by Age of Bicyclist: 1975–1999



SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, Fatality Analysis Reporting System (FARS) database, available at www.nhtsa.dot.gov, as of January 2001.

There were 51,000 bicyclists injured in crashes with motor vehicles in 1999. Although 90 percent of bicycle *fatalities* involve a collision with a motor vehicle, most bicycle *injuries* do not. There are about 500,000 bicycle-related emergency room visits annually [4]. Most bicycle mishaps leading to emergency room visits involve falls and collisions with fixed objects. Collisions with motor vehicles accounted for 15 percent of emergency room visits [3]. Collisions with pedestrians, other bicycles, and animals are prevalent, but states do not generally record these data since they do not involve motor vehicles.

The Bureau of Transportation Statistics' Omnibus Survey of adults 16 years of age or older asked survey respondents to rate their level of concern about specific transportation issues. For bicycle travel, 58 percent indicated they felt "very unsafe" (30 percent) or "unsafe" (28 percent), greatly exceeding the 18 percent who felt "safe" (8 percent) or "very safe" (10 percent). The remaining 24 percent were neutral on this question [5].

Nearly one-third (32 percent) of bicyclists involved in crashes were riding against traffic [1, table 37]. In fact, a study that calculated relative risk based on exposure rates found that bicycling against traffic increased the risk of a collision with a motor vehicle by a factor of 3.6 [7].

Sources

1. Hunter, W.W., J.C. Stutts, and W.E. Pein, Bicycle Crash Types: A 1990's *Informational Guide,* FHWA-RD-96-104 (Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 1997).
2. Pickrell, D. and P. Schimek, *Trends in Personal Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey* (Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 1997).
3. Rivara, F.P., D.C. Thompson, and R.S. Thompson, *Circumstances and Severity of Bicycle Injuries* (Seattle, WA: Snell Memorial Foundation, Harborview Injury Prevention and Research Center, 1996).
4. Tinsworth, D., C. Polen, and S. Cassidy, *Bicycle-Related Injuries: Injury, Hazard, and Risk Patterns,* Technical Report (Washington, DC: U.S. Consumer Product Safety Commission, 1993).
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7. Wachtel, A. and D. Lewiston, "Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections," *ITE Journal,* September 1994, pp. 30–35.

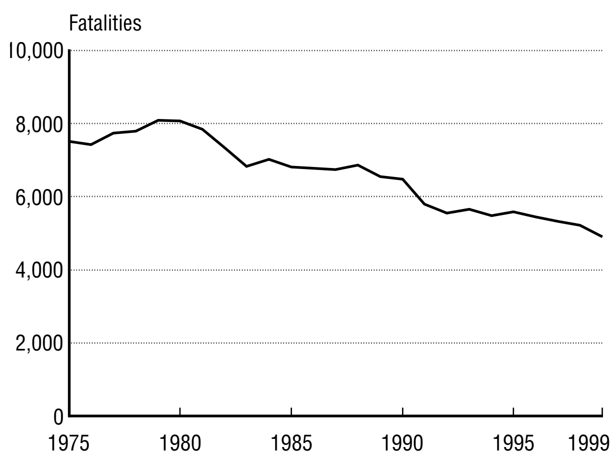
Pedestrians

In 1999, 4,906 pedestrians were killed in crashes involving motor vehicles, compared with 7,516 in 1975 (figure 1). (For 2000, the National Highway Traffic Safety Administration's early assessment of pedestrian fatalities is 4,727.) While pedestrian fatalities have declined, the risk has not necessarily decreased. The U.S. Department of Transportation's Nationwide Personal Transportation Survey shows that walking trips rose from 19.7 billion to 20.3 billion between 1977 and 1995[1] [1]. Table 1 presents factors that can contribute to motor vehicle-related pedestrian fatalities.

Data evaluating exposure risks faced by pedestrians are very limited. State data on pedestrian fatalities per 100,000 population show that, although the levels of fatalities are spread across the country, several states in the southeast, along the Gulf Coast, and in the southwest have higher than median fatality rates (figure 2).

Pedestrians comprised less than 3 percent or 85,000 of the 3,236,000 people injured in motor vehicle crashes in 1999, but almost 12 percent of the fatalities involving motor vehicles. The majority of pedestrian fatalities in 1999 occurred in urban areas (69 percent), at nonintersection locations (78 percent), in normal weather conditions (90 percent), and at night (65 percent). Additionally, males accounted for about 70 percent of the pedestrian fatalities in 1999. An estimated 31 percent of pedestrians killed in traffic

Figure 1
Pedestrian Fatalities in Motor Vehicle Crashes: 1975–1999



SOURCES: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1998* (Washington, DC: 1999).
____. *Traffic Safety Facts 1999: Pedalcyclists* (Washington, DC: 2000).
____. Fatality Analysis Reporting System (FARS) database, 1999.

Table 1
Pedestrian Fatalities, by Related Factors: 1999

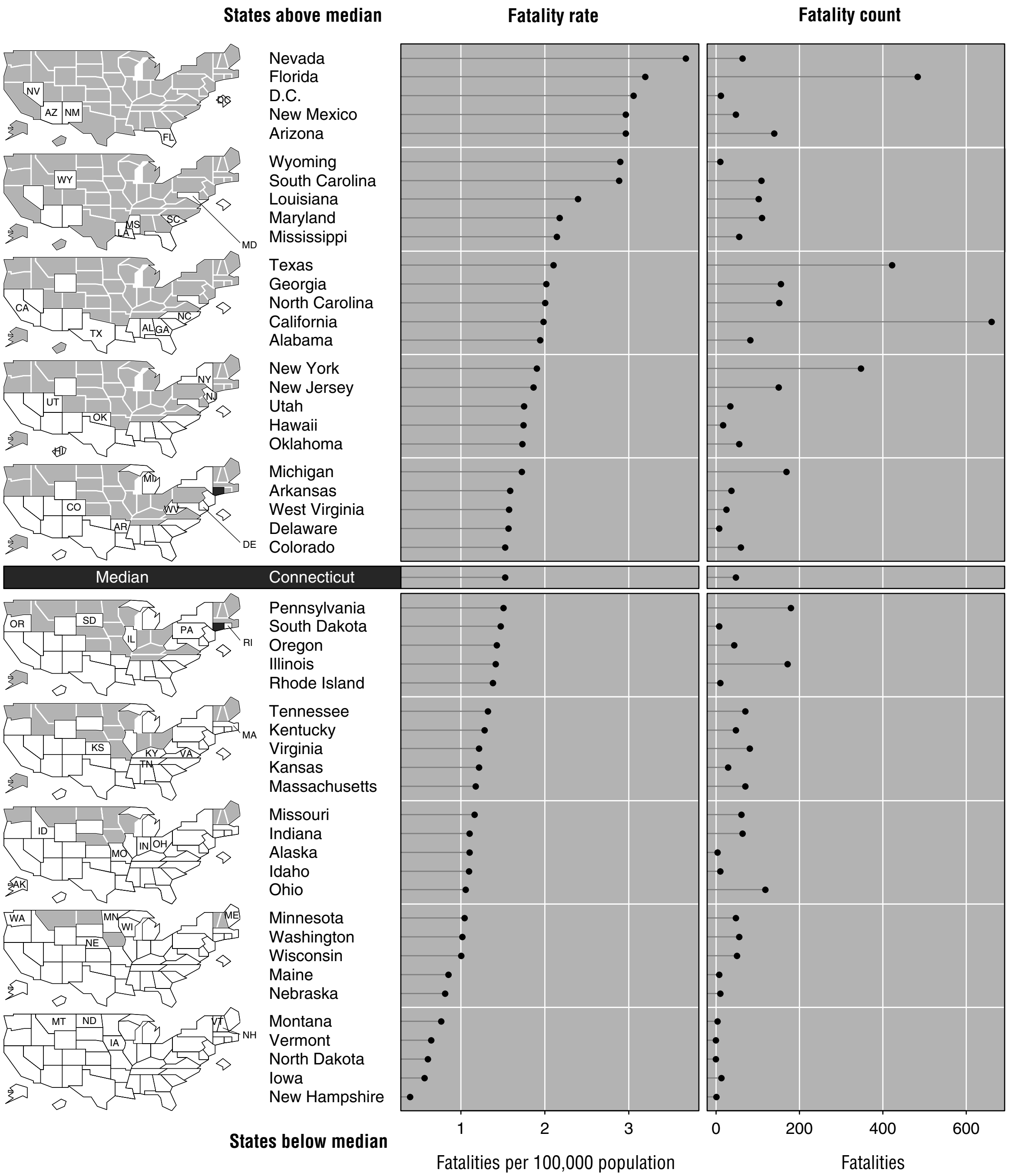
Factors	Number	Percent
Total pedestrian fatalities	**4,906**	**100.0**
Improper crossing of roadway or intersection	1,474	30.0
Walking, playing, working, etc., in roadway	1,420	28.9
Failure to yield right-of-way	672	13.7
Darting or running into road	640	13.0
Not visible	395	8.1
Inattentive (talking, eating, etc.)	107	2.2
Physical impairment	80	1.6
Failure to obey traffic signs, signals, or officer	68	1.4
Emotional (e.g., depressed, angry, disturbed)	21	0.4
Nonmotorist pushing vehicle	20	0.4
Mentally challenged	18	0.4
Getting on/off/in/out of vehicle	16	0.3
Ill, blackout	15	0.3
Other factors	106	2.2
None reported	1,241	25.3
Unknown	98	2.0

NOTE: The sum of the numbers and percentages is greater than the total pedestrians killed as more than one factor may be present for the same pedestrian.

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999* (Washington, DC: 2000), table 98.

[1] 1995 data are the latest available.

Figure 2
Pedestrian Traffic Fatalities by State: 1999



SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Traffic Safety Facts 1999: Pedestrians* (Washington, DC: 2000).

crashes in 1999 were intoxicated (with a BAC of 0.10 or more) as were 12 percent of the drivers in fatal pedestrian crashes [3].

The Bureau of Transportation Statistics Omnibus Survey of adults 16 years of age or older asked survey respondents to rate their level of concern about particular transportation issues. When asked to identify how safe they felt when using specific modes of transportation (e.g., highways, commercial air, intercity train), more respondents felt "safe" or "very safe" than "unsafe" or "very unsafe." However, for pedestrian travel, 43 percent felt "very unsafe" (23 percent) or "unsafe" (20 percent). Only 30 percent said they felt "safe" (16 percent) or "very safe," (14 percent). About 27 percent were neutral [2].

Sources

1. Pickrell, D. and P. Schimek, *Trends in Personal Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey* (Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 1997), also available at http://www.cta.ornl.gov/npts/1995/Doc/publications.html.
2. U.S. Department of Transportation, Bureau of Transportation Statistics, Omnibus Survey, August 2000.
3. U.S. Department of Transportation, Federal Highway Administration, *Traffic Safety Facts 1999: Pedestrians* (Washington, DC: 2000).

Commercial Aviation

Overall, aviation is a remarkably safe mode of transportation. Commercial aviation, used by most Americans when they fly, experiences less than 1 fatal crash for every 1 million flights. While commercial air travel in the United States has increased dramatically over the past two decades, the accident rate has remained low [2]. However, differences exist among the various categories of service that make up commercial aviation.[1]

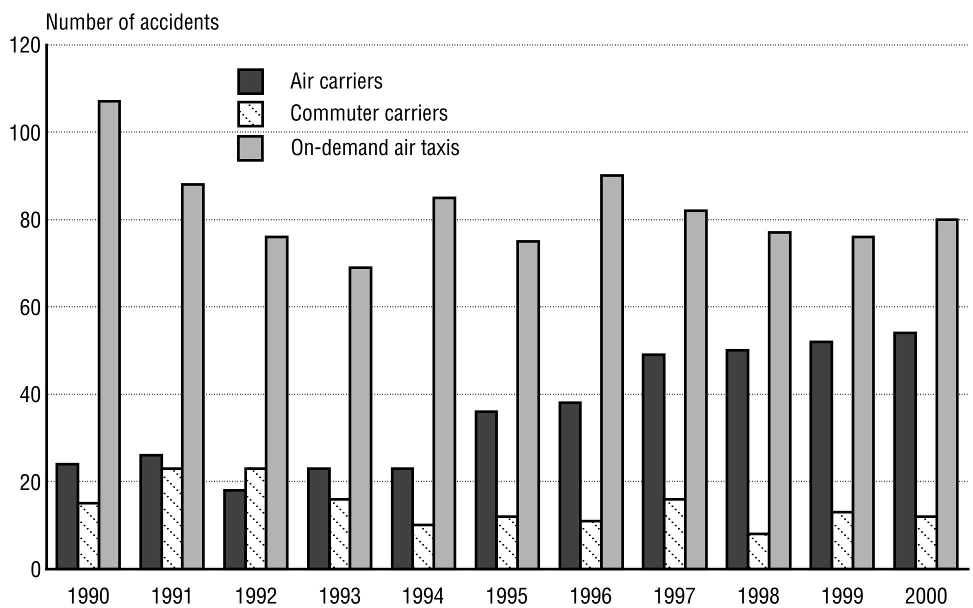
[1] For safety reporting and analysis, commercial aviation consists of air carriers (those with aircraft having 10 or more seats), cargo haulers, commuter carriers (those with aircraft having 9 seats or fewer in scheduled service), air taxi service (those carriers with aircraft having 9 seats or fewer in unscheduled service), and helicopter service.

In 2000,[2] 92 fatalities were reported in U.S. air carrier accidents. For the third consecutive year, no fatal accidents were reported for commercial chartered airlines. Overall, 54 U.S. air carrier accidents were reported in 2000 [1].

Historically, air taxis experience a greater number of accidents than air carriers or commuter carriers (figure 1). However, the number of fatalities across the categories varies greatly from year to year, because a single crash of a major airliner can result in a large number of deaths (table 1).

[2] 2000 data are preliminary.

Figure 1
Commercial Aviation Accidents by Type of Operation: 1990–2000



SOURCE: National Transportation Safety Board, *Accidents, Fatalities, and Rates, 1982–2000* (Washington, DC: 2001).

Table 1
Number of Commercial Aviation Fatalities by Type of Operation: 1990–2000

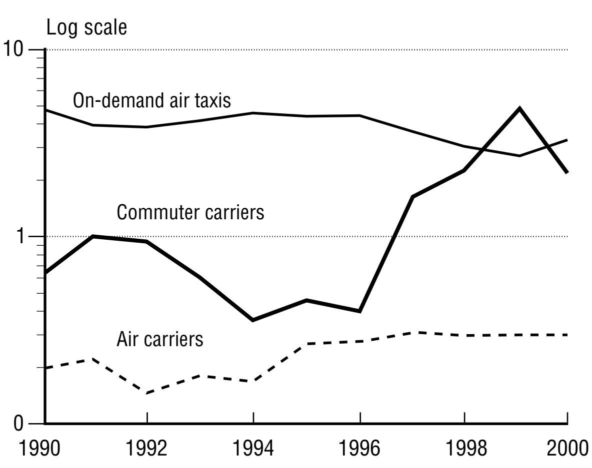
Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Air carriers	39	62	33	1	239	166	380	8	1	12	92
Commuter carriers	7	99	21	24	25	9	14	46	0	12	5
On-demand air taxis	51	78	68	42	63	52	63	39	48	38	71

SOURCE: National Transportation Safety Board, *Accidents, Fatalities, and Rates, 1982–2000* (Washington, DC: 2001).

The overall accident rate for all three types of commercial aviation operations combined is 0.69 accidents per 100,000 flight hours. However, differences in the accident rates among the three types of operations do exist (figure 2). For example, the accident rate for air carriers has historically been well below that of commuter carriers and air taxis.

Finally, although the overall accident and fatality rates for commercial aviation remain low, the continued growth forecast for U.S. aviation in the coming decade raises concern. The Federal Aviation Administration (FAA) estimates that commercial aviation aircraft (excluding air taxis) will fly more than 24 million hours in 2007, a 37 percent increase over 1999. Commercial aviation (excluding air taxis) experienced an average of 6 fatal accidents a year in the United States between 1994 and 1996. If the projected growth in flight hours occurs and the fatal accident rate is not reduced, aviation experts estimate that the number of fatal commercial aviation accidents could rise to 9 per year by 2007. To address this potential danger, FAA's "Safer Skies" program has a goal of reducing the number of fatal commercial accidents per million flight hours by 80 percent by 2007 [3].

Figure 2
Commercial Carrier Accident Rates: 1990–2000
(Per 100,000 flight hours)



SOURCE: National Transportation Safety Board, *Accidents, Fatalities, and Rates, 1982–2000* (Washington, DC: 2001).

Sources

1. National Transportation Safety Board, *Accidents, Fatalities, and Rates, 1982–2000* (Washington, DC: 2001), also available at http://www.ntsb.gov/aviation/htm, as of Apr. 17, 2001.
2. U.S. Department of Transportation, *The Changing Face of Transportation* (Washington, DC: 2000).
3. U.S. Department of Transportation, Federal Aviation Administration, *Safer Skies: A Focused Agenda,* 2000, available at http://www/faa.gov/apa/safer_skies/saftoc.htm, as of Sept. 20, 2000.

General Aviation

Most aviation accidents involve general aviation (GA) aircraft[1] (table 1); however, GA fatalities and fatality rates have decreased over the last quarter century (figure 1). In 1975, general aviation experienced 1,252 fatalities—over twice as many as the 592 reported in 2000 (preliminary data). Moreover, the fatality rate (expressed as fatalities per 100,000 hours flown) declined from 4.35 to 1.92 over the same period [2].

The major causes of fatal general aviation accidents are weather, pilot loss of control or other maneuvering errors made during flight, and accidents on approach to the airport [5]. In fact, 32 percent of the GA accidents from 1983 to 1994 occurred in weather conditions requiring pilots to have instrument ratings [3]. Furthermore, the number of fatalities also varies a great deal by month, with fewer fatalities generally occurring in the winter months because of fewer flights (figure 2).

Another area of concern is the growing number of runway incursions[2] involving GA aircraft. In 1999, GA pilot error caused 139 (76 percent) of the 183 runway incursions [1].

Changes in flight hours can also affect accident rates. The Federal Aviation Administration (FAA) estimates that GA flight hours will increase to about 36 million hours by 2007—nearly 19 percent higher than 1999. Although general aviation accidents and fatalities have been trending

[1] General aviation includes a wide variety of aircraft, ranging from corporate jets to small piston-engine aircraft used for recreational purposes, as well as helicopters, gliders, and aircraft used in operations such as firefighting and agricultural spraying.

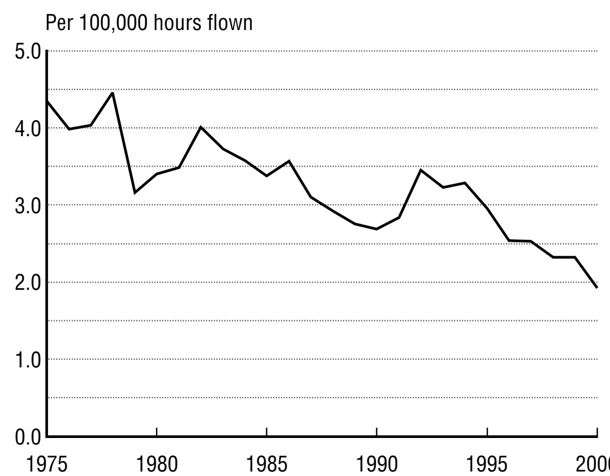
[2] A *runway incursion* is any occurrence on a runway involving an aircraft, vehicle, or pedestrian that creates a collision hazard for aircraft taking off, intending to take off, landing, or intending to land.

Table 1
Fatal Accidents and Deaths by Type of Aviation Operation: 1988–1997

	Fatal accidents		Deaths	
Type of operation	**Number**	**Percent**	**Number**	**Percent**
General aviation	4,386	98	8,046	82
Commercial aviation	85	2	1,756	18
Total	**4,471**	**100**	**9,802**	**100**

SOURCE: U.S. General Accounting Office, *Aviation Safety: Safer Skies Initiative has Taken Initial Steps to Reduce Accident Rates by 2007* (Washington, DC: 2000).

Figure 1
General Aviation Fatality Rates: 1975–2000



NOTE: 2000 data are preliminary.

SOURCES: National Transportation Safety Board, *Accidents, Fatalities, and Rates, 1982–1999* (Washington, DC: 2000), also available at http://www.ntsb.gov/aviation/htm, as of Apr. 17, 2001; and U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics Historical Compendium: 1960–1992* (Washington, DC: 1993).

downward for 25 years, aviation experts believe these numbers will rise over the next decade with the projected increase in flight hours. Because of the potential safety implications associated with rapid growth in both commercial and GA flight hours, FAA initiated the "Safer Skies" program in 1998 with the goal of reducing aviation accident rates. FAA's goal for GA is to reduce the number of fatal accidents to 350 by 2007—a 20 percent reduction from the 1996–1998 baseline [4].

Sources

1. Deyoe, Robin, Runway Safety Program Office, Federal Aviation Administration, U.S. Department of Transportation, personal communication, Sept. 13, 2000.
2. National Transportation Safety Board, *Accidents, Fatalities, and Rates, 1982-2000* (Washington, DC: 2001), also available at http://www.ntsb.gov/aviation/htm, as of Apr. 17, 2001.
3. U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Accidents, 1983–1994: Identification of Factors Related to Controlled-Flight-Into-Terrain (CFIT) Accidents* (Washington, DC: July 1997).
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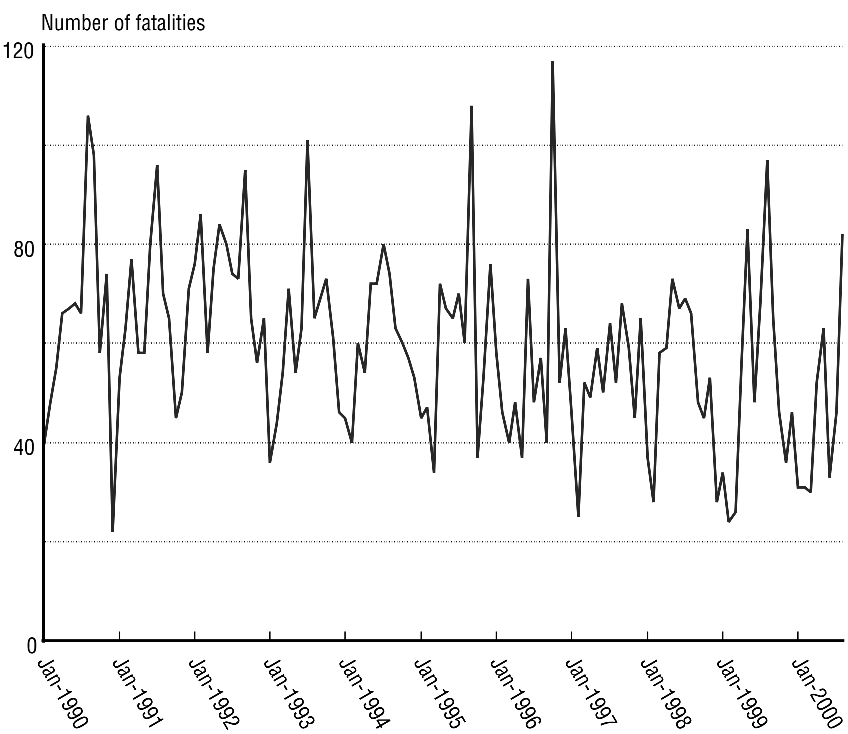
Figure 2
General Aviation Fatalities: 1990–2000
(Monthly data)



SOURCE: National Transportation Safety Board, Office of Aviation Safety, available at http://www.ntsb.gov/aviation.

Commercial Maritime Vessel Incidents

About 50,000 commercial vessels carrying freight and passengers call at U.S. ports every year. In 2000, there were almost 7,000 verified U.S. and foreign vessel incidents[1] in U.S. waters. Over the last six years, the number of commercial vessel incidents in U.S. waters has declined (table 1). Approximately 90 percent of these incidents occurred among 10 vessel types, and this concentration has been increasing since 1997.

Towboats and tugboats have ranked as the number one vessel type involved in incidents since 1994. Prior to 1994, fishing vessels ranked number one; they now rank second. However, the number of incidents involving both of these vessel types has been declining in recent years [5]. Towboats and tugboats primarily push and pull barges on U.S. inland waterways and provide tug assist services in ports and along coastal areas. Towboats and tugboats, which can handle as many as 35 barges at a time, have limited maneuverability, especially when the crew is involved in maneuvering barges [4]. People falling overboard account for the majority of the fatalities in the inland towing industry [2].

A study of U.S. maritime incident data revealed that in 2000 the highest proportion (42 percent) of all maritime fatalities occurred among commercial fishing vessels. The next highest proportion of fatalities were among towboats and barges (11 percent), freight ships (10 percent), and passenger vessels (10 percent) [1]. The U.S. Coast Guard, which estimates that there are between 100,000 to 120,000 vessels in the U.S. commercial

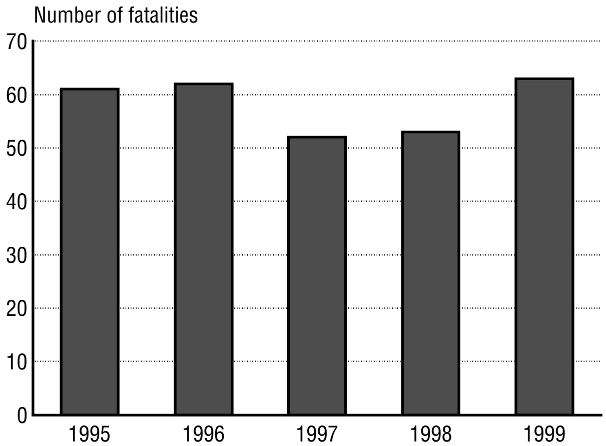
[1] Incidents are defined as collisions, groundings, and "allisions" (when two vessels sideswipe each other).

Table 1
Number of Commercial Vessel Incidents by Type of Vessel—Top 10 Vessel Types: 1992–2000

Vessel type	1992	1993	1994	1995	1996	1997	1998	1999	2000
Towboat/tugboat	1,508	1,690	2,355	2,633	2,429	2,211	2,180	2,049	1,802
Fishing boat	1,984	1,991	1,959	1,546	1,296	1,284	1,154	1,232	1,125
Passenger ship	684	789	932	982	977	903	944	936	908
Freight barge	723	795	909	983	964	792	747	771	640
Tank barge	818	861	1,066	949	799	778	729	647	619
Freight ship	915	955	1,037	937	746	701	689	668	510
Recreational boat	489	639	718	277	189	325	411	437	480
Tank ship	542	545	628	467	355	358	348	286	230
Oversized vessel	210	242	184	135	136	146	179	138	131
Unclassified vessel	146	132	175	153	397	393	223	166	115
Total, top 10	**8,019**	**8,639**	**9,963**	**9,062**	**8,288**	**7,891**	**7,604**	**7,330**	**6,560**
Total, all vessels	**8,734**	**9,457**	**10,852**	**9,806**	**9,191**	**8,915**	**8,479**	**7,862**	**6,903**
Percentage of total, top 10	91.8%	91.4%	91.8%	92.4%	90.2%	88.5%	89.7%	93.2%	95.0%

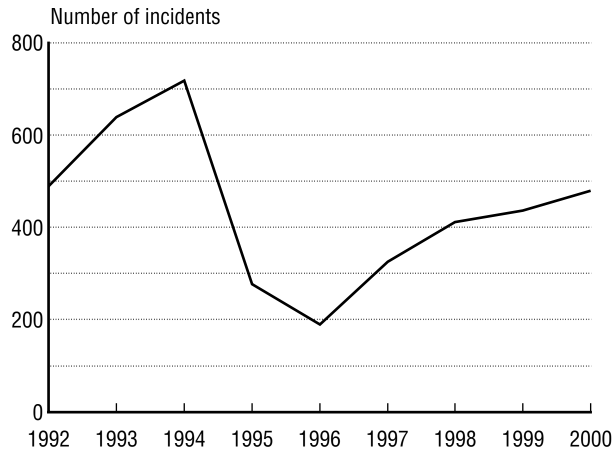
SOURCE: U.S. Department of Transportation, U.S. Coast Guard, Resources Management Directorate, Data Administration Division, personal communication, February 2001.

Figure 1
Worker Fatalities on Fishing Vessels: 1995–1999



SOURCE: U.S. Department of Transportation, U.S. Coast Guard, *U.S. Coast Guard Marine Safety and Environmental Protection Business Plan FY 2001–2005,* available at http://www.uscg.mil, as of February 2001.

Figure 2
Commercial Vessel Incidents Involving Recreational Boats: 1992–2000



SOURCE: U.S. Department of Transportation, U.S. Coast Guard, Resources Management Directorate, Data Administration Division, personal communication, February 2001.

fishing fleet, believes the industry to be one of the most hazardous in the nation [3]. The number of fishing vessel worker fatalities appears to be climbing after a drop in 1997 (see figure 1). This may be due to increased economic pressure and competition in the commercial fishing industry, which encourages risk taking [3].

The number of recreational boats involved in commercial vessel incidents has been climbing since 1996 (figure 2). The safety of these boaters can be dependent on their ability to recognize commercial vessels, particularly tugboats and towboats, and accurately assess their movements [2].

Sources

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2. U.S. Department of Transportation, U.S. Coast Guard, "Epilogue," *American Waterways Operators,* available at http://www.uscg.mil, as of February 2001.
3. ____. *U.S. Coast Guard Marine Safety and Environmental Protection Business Plan FY 2001–2005,* available at http://www.uscg.mil, as of February 2001.
4. U.S. Department of Transportation, U.S. Coast Guard, Marine Safety Office, Providence, RI, available at http://www.uscg.mil, as of Feb. 24, 2001.
5. U.S. Department of Transportation, U.S. Coast Guard, Resources Management Directorate, Data Administration Division, personal communication, February 2001.

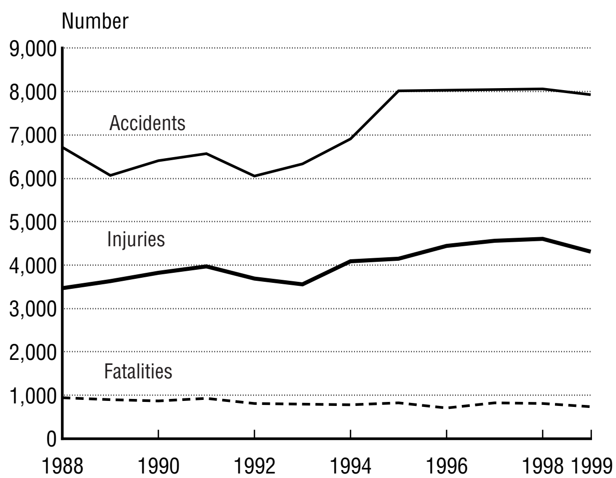
Recreational Boating

Most fatalities, injuries, and accidents on the water involve recreational boating. In 1999, the U.S. Coast Guard (USCG) reported a total of 7,931 recreational boating accidents and 4,315 injuries (figure 1). Personal watercraft and open motorboats account for the highest number of these accidents. Although fatalities remain high, the number has declined from 865 in 1990 to 734 in 1999. In 1999, 34 percent of recreational boating accidents involved collisions with other vessels (table 1). Substantially more drownings were related to the use of open motorboats than for any other type of recreational craft (table 2).

The majority of recreational boating accidents occurred during vessel operation and were caused by operator error, such as recklessness, inattention, and speed (table 3). Alcohol involvement accounted for 6.3 percent of accidents due to operator error in 1999. USCG found that 49 percent of all boating fatalities occurred on boats where the operator lacked safe boating education [2].

Regardless of the cause of the accident or the type of boat involved, boaters can improve their chances of survival by wearing life jackets or using other personal flotation devices (PFDs). Eight out of 10 fatal boating accident victims were not wearing a PFD. USCG estimates that the use of life jackets could have saved the lives of 509 drowning victims in 1998 [1].

Figure 1
Recreational Boating Accidents, Injuries, and Fatalities: 1988–1999



SOURCES: Injuries and accidents, 1988–1998—U.S. Department of Transportation,U.S. Coast Guard, *Boating Statistics – 1998,* COMDTPUB P16754.12 (Washington, DC: Dec. 30, 1999).
Fatalities, 1988–1998—U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001), table 3-1.
All 1999 data—U.S. Department of Transportation, U.S. Coast Guard, Office of Boating Safety, personal communication, February 2001.

Table 1
Types of Recreational Boating Accidents: 1999

Accident type	Accidents	Injuries	Fatalities
Collision with vessel	2,729	1,406	93
Collision with fixed object	881	460	44
Falls overboard	624	439	200
Capsizing	549	269	223
Grounding	507	190	13
Flooding/swamping	460	91	43
Skier mishap	450	444	14
Fall in boat	352	362	3
Fire/explosion (fuel)	222	125	2
Sinking	220	53	29
Collision with floating object	172	63	5
Struck submerged object	161	42	6
Fire/explosion (other than fuel)	141	18	2
Struck by boat	132	112	5
Struck by motor/propeller	99	98	9
Other and unknown	232	143	43
Totals	**7,931**	**4,315**	**734**

SOURCE: U.S. Department of Transportation, U.S. Coast Guard Office of Boating Safety, personal communication, February 2001.

Table 2
Number of Fatalities by Type of Vessel: 1999

Boat type	Total	Drownings	Other deaths
Open motorboat	**408**	294	114
Canoe/kayak	**84**	80	4
Personal watercraft	**66**	15	51
Rowboat	**50**	43	7
Cabin motorboat	**46**	25	21
Pontoon	**20**	12	8
Auxiliary sail	**14**	11	3
Houseboat	**14**	9	5
Inflatable	**14**	13	1
Sail (only)	**5**	5	0
Jet boat	**1**	0	1
Other and unknown	**12**	10	2
Total	**734**	**517**	**217**

SOURCE: U.S. Department of Transportation, U.S. Coast Guard, Office of Boating Safety, personal communication, February 2001.

Table 3
Recreational Boating Accidents Due to Operator Error: 1999

Cause	Accidents
Operator inattention	983
Operator inexperience	947
Careless/reckless operation	830
Excessive speed	676
No proper lookout	588
Alcohol use	337
Passenger/skier behavior	333
Restricted vision	118
Rules of the road infraction	93
Sharp turn	86
Improper loading	68
Overloading	56
Improper anchoring	48
Off throttle steering-jet	42
Standing/sitting on gunwale, bow, or transom	30
Lack of or improper boat lights	21
Failure to vent	15
Drug use	3
Starting in gear	2
Number of accidents	**5,276**

SOURCE: U.S. Department of Transportation, U.S. Coast Guard Office of Boating Safety, personal communication, February 2001.

Sources

1. U.S. Department of Transportation, U.S. Coast Guard, *United States Coast Guard 1999 Annual Report* (Washington, DC: 2000).
2. U.S. Department of Transportation, U.S. Coast Guard, Office of Boating Safety, personal communication, February 2001.

Rail

Most railroad fatalities occur on railroad rights-of-way and at highway-rail grade crossings, not on trains. (Railroad fatalities include people killed and injured in train and nontrain incidents and accidents on railroad-operated property.) Of the 932 people killed in accidents and incidents involving railroads in 1999, only 14 were train passengers. As major train accidents are relatively infrequent, the number of fatalities fluctuates from year to year (table 1). The fatality rate per million train-miles changed little between 1978 and 1993, but since that time has dropped by about 40 percent (figure 1).

Although far fewer people die in highway-rail grade-crossing accidents than in the past, the toll is still large (figure 2). Of the 402 lives lost in 1999 in this type of accident, only 11 were passengers on trains; most were in motor vehicles or on foot [1].

Trespassers not at grade crossings (people on railroad property without permission) accounted for 478 (about 51 percent) of the railroad deaths in 1999. Better understanding of trespassing and its motivations could be essential to addressing this high toll.

Source

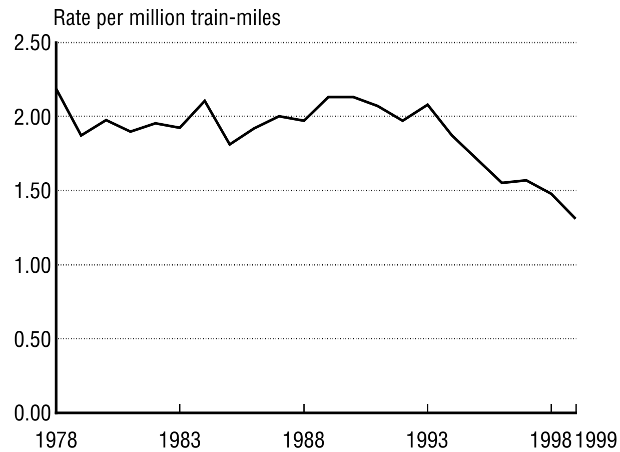
1. U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: In press).

Table 1
Train Accidents and Fatalities: 1978–1999
(Excludes highway-rail crossings)

Year	Accidents	Fatalities
1978	10,991	61
1980	8,205	29
1985	3,275	8
1990	2,879	10
1995	2,459	14
1999	2,768	9

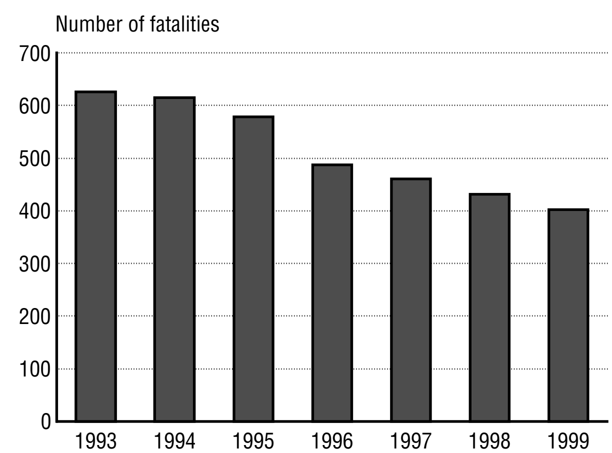
SOURCE: U.S. Department of Transportation, Federal Railroad Administration, *Accident/Incident Overview* (Washington, DC: Various years).

Figure 1
Rail-Related Fatality Rate: 1978–1999
(Including highway-rail grade crossings)



SOURCE: U.S. Department of Transportation, Federal Railroad Administration, *Accident/Incident Overview* (Washington, DC: Various years).

Figure 2
Highway-Rail Grade-Crossing Fatalities: 1993–1999



SOURCE: U.S. Department of Transportation, Federal Railroad Administration, *Railroad Safety Statistics Annual Report 1999* (Washington, DC: August 2000), also available at http://www.fra.dot.gov, as of Nov. 8, 2000.

Pipelines

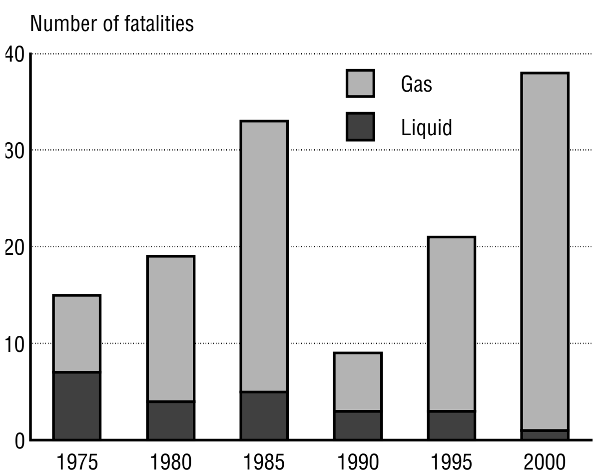
Pipelines carry vast quantities of natural gas, petroleum products, and other materials to fuel the nation's commercial and consumer demands. Pipelines are a relatively safe way to transport energy resources and other products, but they are subject to forces of nature, human actions, and material defects that can cause potentially catastrophic accidents [4].

Major causes of pipeline accidents include excavation, material failure, and corrosion. The U.S. Department of Transportation issues regulations covering pipeline design, construction, operation, and maintenance for both natural gas and interstate hazardous liquid pipelines. The number of fatalities related to pipeline incidents varies from year to year, reflecting the high consequences associated with a limited number of failures (figures 1 and 2). In fact, the 38 pipeline fatalities in 2000 were more than twice the number recorded in 1975 [1].

Many of the hazardous liquid and natural gas transmission pipelines in the United States are 30 to 50 years old. Pipeline age may have been a contributing factor in the violent rupture of a 30-inch natural gas pipeline near the Pecos River in Carlsbad, New Mexico, on August 19, 2000, in which 12 people were killed—the deadliest pipeline accident in the continental United States in almost 25 years. Preliminary examination of the pipeline section that failed in Carlsbad revealed considerable internal corrosion and pipe wall loss greater than 50 percent. This section of pipe was almost 50 years old. Although age alone does not indicate that a pipeline may be unsafe, determining the integrity of pipelines becomes increasingly important as the nation's pipeline systems age [2].

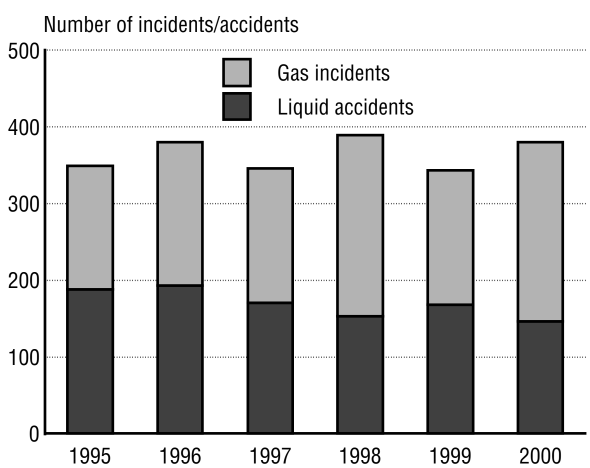
Excavation and other outside force damage are the leading cause of pipeline failures, averaging 39 percent of the total, followed by corrosion with an

Figure 1
Fatalities in Pipeline Incidents



SOURCE: U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety.

Figure 2
Pipeline Incidents/Accidents: 1995–2000



SOURCE: U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety.

average of 20 percent [3]. Other causes of failure are incorrect operation, construction, or material defects; equipment malfunction; and failed pipe. To reduce the problem of excavation damage, one-call notification centers have been established in 48 states and the District of Columbia [1].

Major advances in the materials used for pipes and welding, inspections, and the installation process over the past 25 years have reduced the number of leaks and made those that take place less severe. New corrosion coatings and new application processes have produced dramatically longer lives for pipes.

Sources

1. National Transportation Safety Board, *We Are All Safer,* SR-98-01, 2nd ed. (Washington, DC: July 1998), also available at http://www.ntsb.gov/Publictn/1998/SR9801.pdf, as of Oct. 26, 2000.
2. ____. "NTSB To Hold Pipeline Safety Hearing in November," press release, Sept. 22, 2000, available at http://www.ntsb.gov/Pressrel/2000/000922.htm, as of Oct. 25, 2000.
3. U.S. Department of Transportation, Research and Special Programs Administration, Office of Investigations and Analysis, Compliance Analysis Division, personal communication, June 20, 2000.
4. U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety, *Pipeline Statistics* (Washington, DC: 2000), also available at http://ops.dot.gov/stats.htm, as of Apr. 19, 2001.

Hazardous Materials Transportation Accidents and Incidents

Like all modes of transportation, the movement of hazardous materials comes with the risk of accidents and incidents, including the threat of explosion, fire, or contamination of the environment. The safe transportation of hazardous materials has long been an area of governmental concern and oversight. The U.S. Department of Transportation (DOT), together with the Nuclear Regulatory Commission (for radioactive materials), are responsible for developing safety regulations for the transportation of hazardous materials, including training and packaging requirements, emergency response measures, enforcement, and data collection.

In 1999, more than 17,000 incidents were reported to DOT's Hazardous Materials Information System (HMIS), the primary source of national data on hazardous materials transportation safety. These incidents resulted in 7 deaths and 252 injuries directly attributable to the materials being transported [1]. As shown in table 1, a vast majority (85 percent) of reported incidents occurred on the nation's highways. Although the number of incidents has increased in years, much of the increase can be attributed to improved reporting, an expansion of reporting requirements, and the occurrence of high-consequence, low-probability events.[1] [2]

Two types of data are needed to establish and evaluate the risk of transporting hazardous materials: incident/accident data and flow/exposure data. Through DOT's HMIS database, detailed data are available on hazardous materials transportation incidents and accidents. The release of the 1997 Commodity Flow Survey provided a

[1] A high-consequence, low-probability event is an incident or most often an accident that might statistically occur very infrequently, but results in a catastrophic and tragic outcome.

Table 1
Hazardous Materials Transportation Fatalities, Injuries, and Incidents: 1990–1999

Fatalities

Year	Air	Highway	Rail	Water	Total
1990	0	8	0	0	**8**
1991	0	10	0	0	**10**
1992	0	16	0	0	**16**
1993	0	15	0	0	**15**
1994	0	11	0	0	**11**
1995	0	7	0	0	**7**
1996	110	8	2	0	**120**
1997	0	12	0	0	**12**
1998	0	13	0	0	**13**
1999	0	7	0	0	**7**
Total	**110**	**107**	**2**	**0**	**219**

Injured persons

Year	Air	Highway	Rail	Water	Total
1990	39	311	73	0	**423**
1991	31	333	75	0	**439**
1992	23	465	116	0	**604**
1993	50	511	66	0	**627**
1994	57	425	95	0	**577**
1995	33	296	71	0	**400**
1996	33	216	926	0	**1,175**
1997	24	156	45	0	**225**
1998	20	153	22	2	**197**
1999	12	205	35	0	**252**
Total	**322**	**3,071**	**1,524**	**2**	**4,919**

Incidents

Year	Air	Highway	Rail	Water	Total
1990	297	7,297	1,279	7	**8,880**
1991	299	7,644	1,155	12	**9,110**
1992	413	7,760	1,130	8	**9,311**
1993	622	11,080	1,120	8	**12,830**
1994	929	13,995	1,157	6	**16,087**
1995	814	12,764	1,153	12	**14,743**
1996	916	11,917	1,112	6	**13,951**
1997	1,028	11,863	1,103	5	**13,999**
1998	1,380	12,971	990	11	**15,352**
1999	1,576	14,443	1,061	8	**17,088**
Total	**8,274**	**111,734**	**11,260**	**83**	**131,351**

SOURCE: U.S. Department of Transportation, Hazardous Materials Information System database, 2000, available at http://hazmat.dot.gov.

major expansion in the availability of flow/exposure data. Improvements in highway and air data were particularly noteworthy. Table 2 shows average miles per shipment for the nine classes of hazardous materials. These data are useful for risk analysis, which can provide the basis for informed decisionmaking regarding the safe transportation of hazardous materials.

Sources

1. U.S. Department of Transportation, Hazardous Materials Information System database, 2000, available at http://hazmat.dot.gov, as of Mar. 12, 2001.
2. U.S. Department of Transportation, Research and Special Programs Administration, *Biennial Report on Hazardous Material Transportation Calendar Years 1992–1993* (Washington, DC: 1995).

Table 2
Hazardous Materials Shipments by Class and Miles Shipped: 1997

Class	Average miles per shipment
Flammable solids	838
Explosives	549
Radioactive materials	445
Toxics (poison)	402
Corrosive materials	201
Oxidizers/organic peroxides	193
Flammable liquids	73
Gases	66
Miscellaneous dangerous goods	323
Weighted average	**113**

SOURCE: U.S. Department of Commerce, Census Bureau, *1997 Economic Census—1997 Commodity Flow Survey, Hazardous Materials* (Washington, DC: December 1999), table 2.

Transportation Workers

Occupational risk from transportation incidents is often overlooked in safety analyses. The U.S. Department of Labor, Bureau of Labor Statistics collects data using the Census of Fatal Occupational Injuries. These data classify occupational deaths by event or type of exposure, one of which is "transportation incidents." Transportation incidents are further classified into three additional levels of detail (e.g., highway incident/noncollision/jackknifed vehicle).

For all workers, occupational fatalities in the United States fell slightly from 6,217 in 1992 to 6,026 in 1998. Transportation incidents, the largest single cause of occupational fatalities, however, increased from 2,484 to 2,630 (table 1). Consequently, transportation's share in the total rose from 40 percent in 1992 to 44 percent in 1998. Highway incidents accounted for over half of the transportation-related deaths in 1998. Truck drivers alone made up 14.6 percent of all occupational fatalities, with 879 killed, 721 of them in transportation incidents (table 2). Occupational deaths caused by highway incidents increased by almost 24 percent between 1992 and 1998, while deaths in aircraft incidents decreased by 37 percent during the same period [1].

The risk of being killed while working in a transportation occupation was more than five times the average for all occupations. Among transportation occupations, airplane pilots and navigators and taxicab drivers were at highest risk. Bus drivers had the lowest risk of being killed on the job. Measured by work-related fatalities per 1,000 employees (resulting from all accidents), the risk for all occupations, on average, was 0.047 in 1998 (i.e., 47 workers were killed on duty for every million employees) (table 3). In contrast, the risk for transportation occupations was 0.259.

Table 1
Transportation-Related Occupational Fatalities: 1992 and 1998

	1992	1998
Total occupational fatalities (all causes)	**6,217**	**6,026**
Total transportation-related fatalities	**2,484**	**2,630**
Highway	1,158	1,431
Off-highway road (farm, industrial, premises)	436	384
Air transportation	353	223
Worker struck by vehicle, mobile equipment	346	413
Water transportation	109	112
Railroad transportation	66	60
Other, not elsewhere classified	16	7

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Census of Fatal Occupational Injuries,* 1992 and 1998.

Between 1993 (the first year for which data are available) and 1998, the national average risk, in terms of work-related fatalities per 1,000 employees, decreased 15 percent. For transportation occupations as a whole, however, it decreased only 3 percent, though the risk for taxicab drivers, rail transportation occupations, and water transportation occupations decreased appreciably. In 1993, the risk for taxicab drivers was 1.66 fatalities per 1,000 employees, the highest among all transportation occupations. By 1998, it fell to 0.96, lower than that for airplane pilots and navigators. In terms of percentage change, the decreases in risk for rail transportation and water transportation occupations were even larger—62 percent for rail and 51 percent for water.

Source

1. U.S. Department of Labor, Bureau of Labor Statistics, *Census of Fatal Occupational Injuries,* 1992 and 1998.

Table 2
Occupational Fatalities in Transportation Occupations: 1998

	Total fatalities	Transportation incidents	Assaults and violent acts	Contact with objects and equipment	Falls	Exposure to harmful substance or environment	Fires and explosions
All occupations	**6,026**	**2,630**	**958**	**940**	**699**	**572**	**205**
Transportation occupations	**1,257**	**926**	**96**	**138**	**34**	**39**	**23**
Truck drivers	879	721	30	76	22	21	7
Drivers (sales workers)	36	27	6	–	–	–	–
Bus drivers	13	10	–	–	–	–	–
Taxicab drivers and chauffeurs	82	32	50	–	–	–	–
Airplane pilots and navigators	91	91	–	–	–	–	–
Rail transportation occupations	15	13	–	–	–	–	–
Water transportation occupations	25	18	–	–	–	3	–
Other transportation occupations[1]	116	15	–	–	–	–	–

[1] Includes other vehicle operators, couriers, and material moving labor, etc.

KEY: – = no data reported or data that do not meet publication criteria.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Census of Fatal Occupational Injuries,* 1998.

Table 3
Occupational Fatality Rates of Transportation Occupations: 1993–1998
Per thousand employees

	1993	1998
All occupations	**0.056**	**0.047**
Transportation occupations	**0.267**	**0.259**
Truck drivers	0.328	0.325
Drivers (sales workers)	0.133	0.124
Bus drivers	0.028	0.021
Taxicab drivers and chauffeurs	1.658	0.959
Airplane pilots and navigators	1.188	0.993
Rail transportation occupations	0.464	0.177
Water transportation occupations	0.967	0.476
Other transportation occupations[1]	–	0.126

[1] Includes other vehicle operators, couriers, and material moving labor, etc.

KEY: – = no data reported or data that do not meet publication criteria.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Census of Fatal Occupational Injuries,* 1998.